DOCUMENT RESUME

ED 073 934 SE 015 826

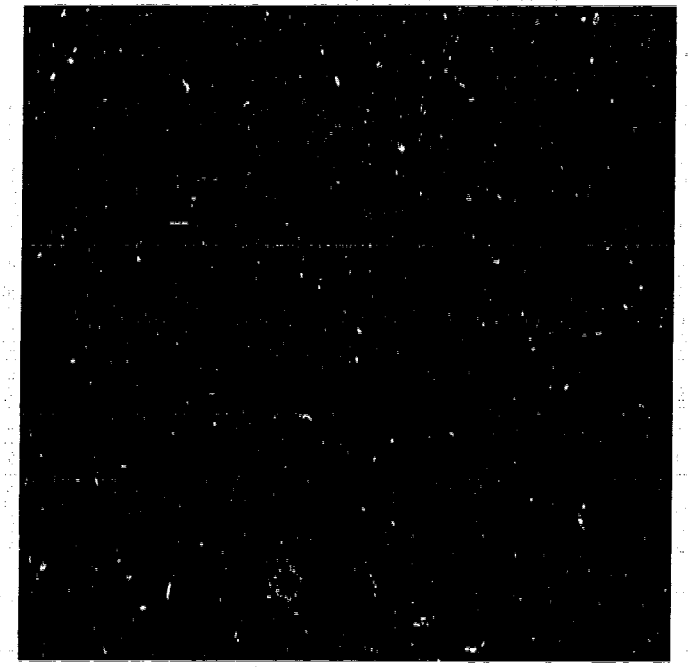
AUTHCR	Simons, Eugene M., Ed.
TITLE	Science Policy Reviews, Volume 5 Number 4.
INSTITUTION	Battelle Memorial Inst., Columbus, Ohio.
PUB DATE	72
NOTE	138p.
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Annotated Bibliographies; *Environment; Literature Reviews; *Policy; Policy Formation; Pollution; Resource Materials; *Sciences; *Technology; World Affairs

ABSTRACT

Presented in this final issue of a quarterly publication are reviews, highlights, and 391 annotated bibliographic references from current and international literature in the area of science and public policy. The literature reviewed includes books, reports, and periodical articles and focuses on matters of broad public policy. In addition to the bibliographic entries, this issue includes four articles: (1) "Each to Do What He Does Best," a statement of specific roles which should be played by universities, private industry, independent laboratories, and government to ensure domestic technological efficiency; (2) "Science and Technology at the Crossroads: Who Should Pay for What?," advice for the rational application of technical and scientific resources toward the solution of today's problems; (3) "Technology Utilization in the Public Sector," a review of the development of a national technology transfer and utilization policy with emphases upon Federal roles including NSF's activities; and (4) "Policies on Science and Technology in Developing Countries: R & D," a comparison of R & D expenditures and technical manpower between the developing and advanced countries. Also contained are an author index, a subject index, and a list of publications screened for this issue with publisher name and address and subscription information. (CC)

Science Policy Reviews

Volume 5/Number 4/1972



Battelle

Science Policy Reviews
quarterly controlled circulation
publication of Battelle Memorial Institute, The Commonwealth
Science Policy Reviews welcomes reactions and comments on its content and coverage. Please address all correspondence to the Managing Editor.
Science Policy Reviews
Battelle
505 King Avenue

Contents

Continued on page 2

About This - the Last - Issue

With this issue, *Science Policy Reviews* ceases publication. It is never easy to announce the end of a periodical, and certainly this announcement is not made effortlessly. But, in looking back over *SPR's* six-year history, we take considerable satisfaction in knowing that it has achieved much of what was intended. It has, we believe, stimulated new interest in the interactions of public policy with science and technology. It has documented the broad range of thought on matters involving science policy or the lack of science policy. And it has helped give identity to the community of scholars and thought leaders writing and speaking on the subject. In marking this last issue of *SPR*, we can only hope that it has also helped to illuminate the path for a successor. / CRT

A Voice From Industry

On the day after our national elections last November, Dr. Arthur Bueche, Vice President – R&D for the General Electric Company, told a spellbound audience at the Battelle Science Policy Colloquium what the U.S. should do to bolster its waning national technological efficiency.

His formula is simple to state; not so simple to implement. It calls for universities, private industry, independent laboratories and the Government to stop competing with one another and for each to concentrate on doing what he does best.

Dr. Bueche spells out the specific role that he believes each of the four institutions should play. He points out that vigorous competition within each area must be encouraged to ensure domestic technological efficiency.

Here is a transcript of his talk.

EACH TO DO WHAT HE DOES BEST

By Arthur M. Bueche

Science Policy – Past

Let's start by summarizing – somewhat bluntly – the unique era of science and technology that has taken place since World War II.

First, we in the technical community never had it so good as during those 25 years – and we may never have it so good again. The growth of science and technology – in both people and money – was spectacular beyond anything even Vannevar Bush or James Conant could have predicted. The accomplishments – many of them – will be a source of awe and pride to mankind for as long as he writes history.

And all of this occurred without really very much coherent formal policy-making. We made unprecedented investments in defense technology because of national fear. We made unprecedented investments in space technology because of national pride (and maybe some fear) – and because, for a time, the American people wanted and enjoyed the thrill of this adventure.

Our national "science and technology policy" was based to some extent on the hope that the results of these defense and space expenditures would inevitably spin-off or trickle down and, pretty much of themselves, solve the rather undefined technical problems of transportation, urban living, environmental protection, and health.

The failure of the "spin-off and trickle-down policy" – it was more of a hope than a policy – is among the causes of our present problem. We should have foreseen it long ago. As one of my illustrious associates says, most of those defense and space investments were so specifically mission-oriented that, if they had been managed 100 percent efficiently, there would have been no spin-off at all.

Science Policy – Present

In any event, today in the 1970's, after those 25 years during which we never had it so good, we find vast numbers of people suddenly saying that science and technology have led to unanticipated harm. We technologists are villains who must be subject to much closer control.

Also there are people – some at very high places – who have the feeling that we already have about as much basic scientific knowledge as we really need, and the job is simply to learn how to apply it better. "Technology transfer" is the buzzword and is all you need to know or do.

Further, many who are outside the technical community looking in have become convinced that the problems of society demand "systems" solutions, and only "systems" solutions, especially if the systems emphasize the contributions of the "soft sciences".

Meanwhile, *inside* the technical community, we are in the throes of unprecedented introspection, self-doubt, some self-pity, agonizing reappraisal -- and, if I haven't already exhausted the cliches, we are searching for the magic that will be provided by some marvelous new comprehensive National Policy for Science and Technology.

Science Policy -- Future

Well, I'm confident that we *will* develop new policies that will help technology solve national and world problems. Certainly we *can* make important steps in this direction through studies, long-range planning, task forces, committees, and other approaches in which the thinking is likely to be dominated by the thinking of members of the technical community themselves.

But on this day-after-election-day, perhaps it is appropriate to remind ourselves that our future Science and Technology Policies will be determined, basically, by some very broad democratic processes.

These days, when some people claim to see science as an enemy of mankind -- and when a vocal minority suggests that we need less technology, not more -- I think we need to remind ourselves that our scientists and engineers, just as our elected officials, have been generally quite responsive to the requirements and desires of the majority of the people.

Viewed in perspective, technology has been remarkedly sensitive to the mood of the public. And as these moods -- desires, wants, needs -- of the majority change, the direction of technology will continue to change accordingly.

This, it seems to me, should be a source of reassurance to the vast share of our citizens, those who find it hard to be "against progress" but who are also concerned about the many problems caused by the misuse of technology.

The People Set Priorites

Technical progress is broadly blamed -- as we all know so well -- for the fouling of our air and the pollution of our streams. But today's ecological situation cannot be wholly separated from the past desires of people -- from decisions made "democratically" over the years in regard to what the majority thought they wanted and needed.

More than a generation ago -- actually, starting in the year 1940 -- our own company tried sponsoring advertisements and producing documentary films that dramatized how pollution was even then defiling our lakes and rivers. The response was, in a word, *under*whelming. In the absence of public concern about the environment, it is not surprising that the technologists produced for people what they showed -- in the marketplace -- that they wanted most: the powerful cars, more things to make jobs easier and life more comfortable and less monotonous, and more and more power to keep these things running.

Now, just in the past three or four years -- with the rather sudden public awareness of environmental problems -- the people's mood has begun to change.

And technology is changing right along with it, with or without a formal statement of policy.

Given assurance that the people really *do* want an improved environment, that their priorities *have* changed, the scientists and engineers stand more than ready to reflect the tenor of the times.

Indeed, many of you have taken the lead -- over recent decades -- in trying to communicate the problems. But you, as scientists and engineers in this country -- like senators and congressmen -- find it difficult to accomplish very much that the mood of the people does not support.

The same general considerations apply when government turns to the technical community for support of its programs. The challenge of a young, vigorous President to "put a man on the moon within a decade" produced a technological miracle. But it simply would not have happened if the people who carried out the space program

had not felt they were getting broad support and encouragement from an interested American citizenry.

Another example: thirty years ago, when secret government directives decreed a program to create a nuclear weapon, scientists and engineers – as citizens of a nation then wholeheartedly committed to winning a war – produced another miracle.

Let me, along this line, propose a hypothetical question. It is interesting – although perhaps idle – to speculate on what might happen now if nuclear physics had somehow developed 30 years slower than it did. Let's assume, for a moment, that everything in today's world is just as it is – including the nation's very different involvement in a very different kind of a war – and it will not be for another three weeks, December 2nd, 1972, not December 2nd, 1942, that some people under the University of Chicago stadium will demonstrate chain-reaction uranium fission. Will we have a successful Manhattan project?

It's a hypothetical question – as I said – and obviously unanswerable. But any conjecture about an answer should recognize that technology is remarkably democratic, dependent on – and reflecting – the will and objective and mood of the majority of the people.

In short, I believe technology tends to strive toward what most people want at any given time. And its record of success, when it has been broadly supported, is truly amazing.

So? We're going to respond to the wants and needs of people and to the pressures of our democratic institutions. We're going to respond to the realities of the times. What *are* the realities of the times?

U. S. Competitive Position Jeopardized

Well, it seems to me that one of the most important of these "realities" is that we are at a turning point, as a nation, in how we are looking at our competitive free-enterprise system.

We have come to this turning point – this crossroads – largely because of technology, *worldwide* technology. Technology has become a critical factor in international competitive success. And the favorable international competitive position of the United States is very seriously threatened – threatened as it has never been before.

Our "balance of payments" problem, the seriousness of which is only beginning to be recognized by the public at large, is – to a considerable extent – essentially a "balance of technology" problem. Technology has become a selective weapon of national policy – in Western Europe, in Japan, in the USSR. And our competitors don't necessarily use our rules. Here at home, the principal competition for U. S. industrial companies today is not other domestic firms but other nations. We're in a whole new ball game.

And, of course, our own domestic government policy is reacting, sometimes badly, to this new "balance of technology" situation. As might be anticipated, domestic government policy has become increasingly activist – to stimulate growth, to eliminate recessions, to redistribute income, to seek selective incentives and penalties to guide the character of economic growth – and thus technology – and to keep us competitive as a nation.

The problem – the enigma – is that much of what we do to try to become *more* competitive *internationally* tends to make us *less* competitive *domestically*. The end result, of course, is that we become less competitive *both* domestically and internationally.

Item: The government feels it must bail out private companies that get in trouble.

Item: The government feels it must itself collect and disburse and itself *use* more and more of the funds available for research and development – not just for defense or space, but across the technology board.

Item: The threat of government R&D – takeover forces private industries into cooperative R&D efforts which, unless

managed with exceptional skill, will reduce the competitive nature of American industries which has provided so much of our national progress.

Policy for the Job Ahead

Our challenge, then, in seeking a new science and technology policy, is

- to respond to the individual wants of the people
- to respond to the pressures of democratically constituted institutions
- to assure national technological growth and progress that will keep us internationally competitive
- to do all this without losing the domestic, internal, individual spirit of competitive free enterprise which has given us what we seek to preserve.

The answer, it seems to me, is to ensure our national technological *efficiency* -- and thus our international *competitive* position -- by dividing the basic, obviously different, elements of the total job into discrete assignments for universities, private industry, independent laboratories, and the Government.

We must do everything we can to devise an R&D structure that will reduce the waste and confusion of government competing with industry, industry competing with universities, and so on down the line. At the same time, we must do everything we can to ensure our *domestic technological efficiency* by providing every opportunity for competition *within* areas to which parts of the job have been assigned.

Competition between universities is nothing new, especially on Saturday afternoons during the fall of the year. But their competing with the people who play football on Sundays and Monday evenings would likely not be in anybody's best interests.

Independent laboratories -- in spite of the "non profit" label -- surely find strength and satisfaction from competing against each other.

I trust industrial technical competition is too much a part of our way of life to require discussion here today.

And even within and between government agencies, if their missions have been logically assigned, I see no harm in the kind of competition that makes all of us, as individuals and team members, do a better job.

In other words, our science and technology policy must -- in the long run -- be simply a means for seeking better ways to ensure that EACH WILL DO WHAT HE DOES BEST.

I'd like to give you a few of one man's thoughts about what I think each can do -- and should do -- and will do best.

First of all, since we are talking about science AND technology policy, we have the distinction between those two terms. Without becoming embroiled in any semantic arguments today, let's just say that "science knows" and "technology does."

The Universities' Assignment

Science is the particular province of the universities in my mind, and they should focus their efforts in that realm. They've gotten off that track largely because priorities in government funding of R&D have tended to distort the traditional university focus on teaching and research. There has been far too much emphasis on mission-oriented work in the universities, and the consequence is a major threat to the structure of our entire system of higher education.

I believe the *universities* should drastically reduce their short-range, technology-focused work. It is quite possible for science to be speculative -- and long-range -- and at the same time relevant. You don't have to be short-range to be relevant.

Further, I think the universities should place more emphasis on new ideas in key areas rather than on developing large stables of graduate students. They must return to the objectives of quality instead of volume-of-output (maybe societal trends will take care of that!), and as a result we might as

well all recognize that the period of rapid buildup of universities and graduate schools should be a thing of the past.

Industry's Assignment

Technology is the particular province of *industry* — let it fulfill that role. Technology sits astride society's continuing struggle to make optimum use of limited means to satisfy our virtually insatiable desires. This process requires making trade-offs to achieve the most efficient utilization of resources and is the foundation of industrial expertise. As such, it has been a cornerstone of our traditional economic growth.

The profit system continues to be attacked by people who don't understand the necessity of capital formation. Additionally there is another — often unrecognized — threat to industrial competition. This is the idea that even though it may be somehow acceptable for industry to make a profit selling to individuals, it's wrong to make a profit selling to the government or serving general social needs.

It's OK to make a return-on-investment selling a machine that improves the efficiency of a manufacturing line, but — according to the mighty curious reasoning of some — it's hardly cricket to do more than break even (if that) in inventing and manufacturing and selling a machine that improves the efficiency of health services.

The fact remains that profitability is still the best measure of social efficiency we have been able to devise.

Only the most intense continuing competition — *between industries* — will assure the development of the comprehensive measures which industry will have to have in order to make the increasingly complex trade-offs of the future — trade-offs that will encompass such profound problems as the world-wide distribution of resources as well as the protection of the environment.

Independent Laboratories' Assignment

The non-profit technical R&D institutions — and the research-conducting foundations — are unique in our society, and they are invaluable in helping make up for some of the deficiencies in our system.

These independent institutions have a role in supplying technical aid to businesses too small to undertake work independently on their own. In addition, they provide an important means of pooling efforts and seeking alternate approaches to satisfying needs. These aspects of the work of the Battelles and their competitors are well known.

More important, however, is the creative, pioneering role of the non-profit and endowment-supported institutions in performing research on social problems in advance of society's general recognition of a need. These are the problems that are not yet well enough perceived to attract government support — or those that will be ignored by universities because the required areas of study cut across the traditional departmental structure of our institutions of higher learning. Along these lines, I think at once of the outstanding job you Battelle people are doing on behalf of developing nations abroad and Appalachia here at home.

Also of great importance, I believe, the independent research institutions must take a major role in the process of science and technology definition, and restructuring — and assignment of broad basic responsibilities — that I've been talking about.

You, the Battelles, may be in the best position to provide objective advice and guidance in the job of policy determination now confronting us as a nation. Why shouldn't you serve as an essential — and badly needed — bridging mechanism between government agencies and the industries about which these agencies frequently know all too little?

In this regard you can give us, in industry, invaluable help as we seek to increase industrial participation in Federal panels and committees — the OST's, NFS's, OMB's and newer agencies — so that we can make our appropriate contributions to the day-to-day work of establishing science and technology policy. We urgently need to increase

government-industry rapport by encouraging such things, for example, as reciprocal internships at managerial levels, particularly with government agencies whose charters deal with attacking major societal ills.

Of course, I trust the non-profit, independent organizations will do all of these jobs I have suggested for them *competitively!*

Government's Assignment

Now, then, what is the role of the *Government* in all of this? Again, I offer one man's opinion.

First of all, it is Government's job to protect the viability of our *science base.* The best way to do this is through greater support of university research -- but, let me emphasize, non-mission-oriented research with emphasis on quality not quantity. The DOD provided some sub-rosa support for this kind of university science for many years, and we must be eternally thankful that it did. Now, however, as the National Science Foundation's role increases -- and if the NSF knuckles under to increasing pressure to emphasize short-range, mission-oriented grants -- we have cause for serious concern. Being aware of the need for "relevance" is essential, but the fact is that we simply don't *know enough* to apply *mission-orientation* to basic science with great certainty.

It is also the Government's job to lead in defining national technology requirements, to appraise the adequacy of the present structure and mechanisms to meet the requirements, and to initiate changes in structure, mechanisms, and allocations of resources where the situations warrants.

Here are some specific examples of actions I think the Federal Government should take in this area:

- Government should, with care, increase its support of social science R&D. Many of our problems today are obviously more social than technical in nature.

- Government should examine the laws and actions of regulatory agencies to ensure that they do not -- either advertently or inadvertently -- stifle technological advance in regulated industries.

- Government should undertake risk-sharing programs with industry on those very large programs of national importance -- such as the breeder reactor -- which industry cannot afford to undertake alone.

- Government should encourage -- financially, if necessary -- small industries to collaborate in conducting R&D programs, either through existing non-profit organizations such as Battelle or through the R&D efforts of trade associations.

- Government should encourage in-its-own-house growth of skills in technology transfer, particularly in collaboration with industry; for example, it should bring the proficiency in this regard of the National Institutes of Health and the Department of Housing and Urban Development up to the level of the Atomic Energy Commission.

In short, it is essential for the Government to provide sufficient stimulus, and perhaps support, for technology to ensure that the *total* national technological effort is adequate to protect our international competitive position.

We have talked of the "responsiveness" of technology to the needs and wants of people. Viewed this way, Government's role in the technological process is to channel the *public will* into support of coordinated programs of a size sufficient to improve the chances of success.

Today's great challenge for Government, then, is to devise new and more effective institutional arrangements -- to achieve some kind of order out of the jurisdictional hodgepodge (productivity vs. environment vs. energy, for example) that smothers some of our best technical efforts -- and make it possible for people to reap the full benefits of our nation's unparalleled scientific and engineering skills.

In doing this job, our public servants -- those elected yesterday by competitive, free-election processes -- should not forget that the com-

petitive free-enterprise marketplace permits people to say what they think, and show what they want, every bit as democratically as do elections, and on a constant day-to-day basis.

Government support and performance of research and development — just as Government activity in every arena — needs to be limited to what the private sector cannot adequately do for itself.

I guess that's what I'm trying to say when I suggest that the basis for any national science and technology policy must simply be that "each must have the opportunity to do what he does best."

Mend Thy Ways!

This fatherly advice to the scientific/technical community and to Government, industry, universities, and labor, is offered by Battelle's Director of Planning as the key to the rational application of technical and scientific resources toward the solution of today's problems.

The profound changes ushered in by the 1970's, he says, call for a "renaissance" in two areas. First, the scientific/technical community must force itself to become much more acutely responsive and adaptable to the needs of society. Second, Government, industry, and labor must form workable, realistic, and efficient "coalitions" with one another so that science and technology can be put to better use in the interests of mankind.

Here is his exposition.

SCIENCE AND TECHNOLOGY AT THE CROSSROADS: WHO SHOULD PAY FOR WHAT?*

by Gabor Strasser

Problems of Society

Changes. Today more things are changing faster than ever before. The leverage we exert on our fate through technology and other means is unparalleled in man's history. The irreversibility of many of our actions is increasing in number and severity. Nations all over the world are caught up in a reexamination of their values and a reordering of their priorities.

Disparities. Resources are strained by the combined effects of population increase and the ever-rising expectations of peoples everywhere. There is a gap between our aspirations and what we can afford. At present this gap is increasing. For the sake of world order, somehow we must arrest this ever-widening gap and then reduce it.

Three obvious ways in combination come to mind to accomplish this. One, we must become more selective in our aspirations and more knowledgeable about trade-offs, realizing that a choice to get something, automatically (even if only implicitly) precludes getting other things, due to overall resource limitations. Two, through technology and other means, we must continue to strive for the ingenious and efficient use, as well as the "recycling" of our ambient natural resources. Three, we should concentrate not only on how to make things better, but also on how to use them better; that is, we should be focusing as much on the efficiency of consumption as we have been on the efficiency of production.

We postulate national programs in the U.S. in such desirable areas as health care delivery, education, economic development, and the amelioration of environmental pollution or urban blight, among many others. Most of these are defensible in their own right. It is when we try to put them all together that we run into trouble. For example, the rationales for such desirable efforts are often in conflict. Or, the total costs of individually desirable and defensible Federal programs may exceed not only the Federal budget, but the GNP many times over.

Today, more than ever, the country needs to avail itself of the kind of rational approaches that the scientific/technical community, in combination with others could provide, in coming to grips with our pressing national problems in some mutually consistent fashion.

The Nation Versus the Scientific/Technical Estate. Unfortunately, we find ourselves in this situation at a time when the nation as a whole and the scientific/technical estate are somewhat at odds with one another. The anti-war movement of society unfairly

*Presented at the Annual Meeting of the AAAS, Washington, D.C., December 29, 1972.

developed into an anti-science and -technology mood. Also, society has violently reacted to some of the deleterious side effects of its own decisions (for example, pollution, urban blight, toxic side effects of herbicides and pesticides, etc.). When these have manifested themselves through the application of technology, society placed the blame on science and technology. Thus the technology assessment concept was born. Of late, it is beginning to be recognized that it is wrong and even destructive to blame science and technology for the negative consequences of socio-political, or socio-economic decisions, even though science and technology have been used in the process.

Problems of the Scientific/Technical Estate

It would also be sheer folly to blame society solely for the drifting apart of the nation and the scientific/technical community. There may be some confusion within the scientific/technical community about the nature of its role within society as a whole.

Why Science and Technology Are Supported. Most of the financial support that the scientific/technical community has enjoyed in the past can be directly traced to some "market-pull", whether stemming from government or industry. This is true of the entire spectrum of scientific/technical activities ranging from Basic Research through Applied Research to Technology. I am willing to defend this assertion, if you allow me to add the modifier of "Targeted" to Basic Research. This, incidentally, rarely bothers the researcher himself.

The lion's share of support for scientific/technical activities comes from government or industry, when two conditions prevail:

(1) When goals are highly science/technology-dependent, and
(2) When the government or industry believes that the scientific/technical community is able and willing to help attain such goals.

Relying purely on altruistic rationales for the financial support of science and technology would result in support that is comparable to what other endeavors of our Western cultural heritage are receiving, such as art, music, or philosophy, for example.

A Historic Perspective of Support for Science and Technology. During the 1950s and 1960s about two-thirds of our entire Federal budget was spent on national goals and priorities in the areas of defense (DOD), space (NASA), and atomic energy (AEC). Programs to develop new sophisticated weapons systems, to go to the moon, and to develop large-scale nuclear devices critically depended on scientific and technical contributions. Yet, the bulk of these huge expenditures went for "nonscientific" things, such as physical plants, materials, labor, production, etc. Only a "relatively" small fraction was spent for science and technology, per se.

Hence, science and technology have enjoyed a unique combination of two desirable characteristics. They have been (1) critical to the attainment of our national goals, and (2) they have been "relatively" inexpensive. For these reasons, support for scientific and technical activities has grown at an unprecedented rate. There were no misgivings about such growth, and perhaps even less about the efficiency of the scientific/technical process as such. But why should there have been any? Not infrequently a multimillion-dollar hardware system production had to wait for some scientific/technical breakthrough which may have cost, in sharp contrast, a mere one hundred thousand dollars -- and often much less.

Need for Some Introspections. It is imperative that we recognize at this junction that the generous past financial support for our activities was provided by the socio/political system, not because society and government viewed scientists and engineers as an unusually deserving special breed. Most of the support was forthcoming, because what the scientists and

engineers had to offer was both (1) "relatively" inexpensive; and, even more important (2) essential to the pursuit and attainment of those objectives which the nation then considered of primary importance.

If you question the validity of this assertion, compare, for example, the monies spent in the 1950s and 1960s on basic research in electronics, with those devoted to similar endeavors in anthropology.

Such facts must be recognized as well as adapted to, in view of current realities, by the scientific/technical community, before the relationship that it enjoyed with the rest of the nation for over two decades can be reestablished. This will be anything but easy, since it calls for numerous realignments within the scientific/technical community which may conflict with the vested interests of its leaders.

The dependence of the nation and the scientific/technical community upon each other for their mutual benefit is past history, present reality, and is a demonstrable fact for the future. However, the nature of this relationship must be based primarily on national needs, rather than the other way around. Note that this is not a generic departure from past practice, even though the character of the relationship got obscured by the highly technology-intensive nature of most of our major national programs during the '50s and '60s.

Turning Liability Into Opportunity. As alluded to before, today there does exist a chasm between the nation and the scientific/technical estate. Rather than treating this chasm as a liability, we should view it as an opportunity to be bridged for the benefit of the nation as a whole, as well as of the scientific/technical community.

The Nature of Emerging National Needs

The Changing Nature of Society's Dependence on Science and Technology. What we are experiencing today is a change in the degree, nature, and dependence of our emerging national and industrial goals upon science and technology.

While the solutions to most of our problems will continue to depend heavily on science and technology, for a while, at least, they will depend less than they used to, on *new* science and technology. This is so because what *primarily* impedes progress today is not a want for more or better science and technology. Rather it is due: (1) to the inadequacies of our other "enabling mechanisms", and (2) to our inabilities to orchestrate off-shelf knowledge from the various disciplines, to create the kind of interdisciplinary approaches which are required for the solutions to most of today's problems.

Disparities Among Our "Enabling Mechanisms". Our scientific/technological capabilities, when viewed as "enabling mechanisms" have way outrun in quantity, quality, sophistication, and effectiveness most of our other "enabling mechanisms". These include our abilities to (1) govern ourselves, (2) to resolve societal conflicts, (3) to "agree" on what a better quality-of-life is, (4) to render law and justice, (5) to decide the kind of education we need and then provide it, (6) to determine the kind of health care we should have and then deliver it, (7) to resolve public versus personal rights in a pluralistic society, (8) to differentiate between and cope with government-imposed risks upon, and self-assumed risks by the individual citizen, (9) to effectively arbitrate hosts of individually defensible, but when taken together, conflicting positions for some common good, and (10) to develop policies and mechanisms whereby effective resource development and equitable public consumption could be brought into some better balance, thus reducing disparities that generate conflicts.

As a result society began to view the improvement of these less-developed but essential "enabling mechanisms" as more important than to concentrate on the

further fine-tuning of science and technology. Hence science and technology have been nudged from center stage.

Lack of Interdisciplinary Capabilities. Our difficulties in building interdisciplinary teams, to address problems whose solutions are multidisciplinary in character, have been treated extensively in the literature. Let me just say that many institutional, disciplinary, political, and other coalitions will have to be realigned before effective interdisciplinary capabilities could come into being. I expect that many old "building blocks" will remain – even if in different combinations and with some modifications. At the same time, some of these blocks will disappear altogether, and some necessary new ones will emerge, perhaps for the first time. All of this will probably raise havoc with existing institutional systems, and vested interests.

Are We on the Threshold of a Needed Renaissance?

The Need For, and Rewards of Adaptability. What does all this add up to? Profound changes are in the offing throughout the world, calling for much greater adaptability by the scientific/technical community than what it has become accustomed to during the past quarter of a century. What we may be talking about is nothing short of a needed renaissance.

Fires for such renaissance are fanned by obvious economic and social pressures. At the same time they are dampened by those who are most threatened by it; and who, incidentally, are often in positions to generate the greatest inertia.

Yet, such renaissance is one of the prerequisites to reestablishing a constructive, effective relationship between the nation as a whole and the scientific/technical estate. As a result, the "market-pull" for science and technology (even if in different forms from what we have been accustomed to) could get a substantial boost. This would be in the best interest of not only the scientific/technical community, but also of the nation as a whole.

Renaissance Doesn't Come Cheap or Easy. I, as a member of the scientific/technical community, must admit to viewing the developments with some apprehension.

I see, with increasing frequency, references in the press to the eroding influence of our Office of Science and Technology.

I wonder about the abilities of our scientific/technical community to join forces with other "enabling mechanisms" and disciplines, in light of the nature of the dialogues between our National Academy of Sciences and our National Academy of Engineering.

I see our National Science Foundation, originally created and staffed to provide a "balance wheel" for the support of basic research by the grant-mode operation, attempting entirely different roles, unsuitable for them, without appropriate and considerable changes in their organization, approach, and personnel.

I see universities clinging to obsolete technical (as well as other) curricula in light of the needs of the '70s, without making sufficient headway in training members for the kind of interdisciplinary teams that are badly needed today and are essential for tomorrow.

Speculations on Our Epitaph. One cannot help but wonder if history will recall our generation of scientists and engineers as the one which reached for and captured the moon – which brought forth medical progress, the like of which would have been considered miraculous a mere decade ago – and, whose efforts were primarily responsible for the more than doubling of the standard of living in less than one generation. All of these feats derived from our scientific/engineering talents.

But what about our nontechnical talents, vision, and flexibility as members of society? Will we also be recalled as the generation which could not adapt to the changes ushered in by the 1970s, and the world had to wait for the next generation of scientists and engineers to help it solve

its problems?

Who Should Pay for What?

Without making some visible progress toward the needed renaissance alluded to before, it is difficult to be specific about who should pay for what, since we seem to be lacking some rational and accepted context in which to do so.

Technology and Applied Research. It is reasonably clear who should pay for technology. Namely, the user. One can also argue that by and large he should also pay for applied research when it is viewed as a necessary endeavor to fill some gaps in technology before the latter can be put to use. This is a rather simplistic view, but basically, I believe, it is correct.

At the same time we must realize that today it is impossible to view technology outside the combined contexts of government, industry, labor, and the ever more complex marketplace. All of these greatly impact on decisions concerning what technologies to develop, for what purpose and for what markets. Basically, the name of the game is competitiveness on the world market, which in turn greatly depends on productivity.

The ability of the United States to exert substantial control over most of the world's economies is diminishing. With trends toward reduced trade barriers and vastly improved communications and transportation systems, the "shrinking" of the world is accelerating. Many old political practices and geographic barriers are ceasing to constrain the current movement toward a "more integrated" world – a world where no part remains totally unaffected by what happens in most of its other parts. Hence, attempting to view the U.S. outside some world context is simply naive, be this in the area of science and technology, or trade, or even life styles.

Under the label of "Yankee Ingenuity" new coalitions must be formed (1) to improve our productivity at home and (2) to compete successfully on the international marketplace. Unless we do both, we as a people cannot continue with the life styles to which we have become accustomed.

Insofar as the domestic scene is concerned, the chronically low productivity increases of the "service sector" (which now represents over 50 percent of our total national labor force), markedly depress the national average. The productivity of the service sector simply must improve. Success in this endeavor will greatly depend on innovation, especially technological innovation – a great opportunity for science and technology.

Insofar as international markets are concerned, it is generally recognized that our best hope lies in technology-intensive products, especially where the process of manufacturing has not yet become "routine" or easily "copiable". This, again, certainly represents fertile grounds for scientific/technical opportunities.

The combined contexts I spoke of before would create the milieu in which essential national goals and scientific/technical opportunities could be more easily realized. What are these combined contexts or coalitions? Basically they represent changes in the attitudes of Government, industry, labor, and market selectivity.

In the case of the *Government*, many industrialists feel that some of the current antitrust legislation no longer serves the purpose for which it was enacted, while at the same time it handicaps U.S. industry on the international market. Also, some small businesses cannot take collective advantage of some R&D or other resources which practice, ironically, may be not against but in the public interest. Hence, why not re-examine and change as appropriate. Insofar as our patent laws are concerned, allegedly some similar arguments hold. One example is the numerous U.S. patents which can be licensed only on a nonexclusive basis. There is great reluctance to undertake the turning of such patents into marketable and hopefully profitable products on this basis. The process is risky and expensive, and unless

the entrepreneur has some protection against others moving in on him, he will be reluctant to proceed.

In the case of *industry*, genuine attempts to increase productivity and become less reliant on "protectionistic" measures and "subsidies" are called for. However, unless the environment is conducive to turning a fair profit, industry cannot be expected to champion changes in this direction.

In case of *labor*, it must realize that unless we as individuals, as industries, and as a nation remain competitive, we will all lose out at the end. Such competitiveness is strongly dependent on productivity. An active adversary attitude about how productivity increases should be shared (e.g., increase in real wages) is futile, as long as we are having difficulties bringing about such increases in the first place. Other increases are usually inflationary and hence non-real.

Insofar as *market* selectivity is concerned, we should realize that there are certain industries within the U.S. where irrespective of what we do, we could not become competitive. We should try to determine where and when to "let go", so that our resources won't be wasted on a "losing battle", but will be spent on "win situations".

These are the kinds of necessary changes before we can rationally determine what technologies to support, why, by whom, and for what markets.

Basic Research. Who should pay for basic research is a more complicated issue, but for different reasons. This activity is difficult to relate to desirable end products, yet it represents the wellspring for applied research and technology. It is clear that one cannot "schedule a discovery" resulting from some basic research efforts. Hence, rationalizing support for basic research on the basis of prospective payoff is not feasible. Why, then, support basic research with payoff in mind?

First, if we sought support for basic research on the basis of altruistic considerations (science for science's sake) alone, the support we could expect would shrink to something that the fine arts are enjoying today, as mentioned before. Second, even though we cannot rationalize basic research with *prospective* payoff in mind, *retrospective* evidence, as to the ultimate utility of basic research, is in abundance. Here are some examples: (1) Maxwell's well-known work at Cambridge in the last century directly led to the development of today's enormous and world-wide electronics industry; (2) Townes' applied research in the use of molecular levels to build a highly accurate clock led unexpectedly to the laser, with many proven and expected applications for the benefit of mankind; (3) obscure studies in polymer chemistry spawned the nation's huge plastics industry; (4) Fermi's studies in artificial radioactivity paved the way for atomic power plants; (5) modest studies in hormone and steroid chemistries led to birth control pills.

Also, as mentioned before, basic research serves as a wellspring for applied research, and in turn, for technology. Therefore, without basic research our scientific/technical progress would eventually come to a halt. This would have dire consequences, since, in turn, economic progress, as well as improvements in our standard of living or quality of life, extensively depend upon scientific/technical progress.

Yet, if we were to ask: "How would we divide X number of Federal dollars for basic research among the various scientific disciplines", I wonder if we could offer a defensible answer. How much basic research should companies underwrite, and how should specific areas of investigations be selected? When is it appropriate for the Federal Government to support basic research and in what fields? These are some of the ever-present nagging questions.

Whether or not a given basic research effort will "pay off" is uncertain. Hence, underwriting it involves a risk. Whether or not such a risk is undertaken by industry, depends on three things: (1) the estimated

probability of the "payoff", (2) the magnitude of the "payoff", and (3) the acceptability of the size of the required initial investment. There are many instances where all of these three requirements are met and as a result industry spends millions of dollars on basic research. Perhaps the pharmaceutical industry is as good an example as any.

But, what happens when a given opportunity gets superior marks on the first two criteria, but because of the complexity of the opportunity vis-a-vis the fragmentation of our industries, or because of the size of the required initial investment, no one company, industry, or group of industries can exploit the opportunity? What if such an opportunity is definitely in the national interest? Should, then, the Federal Government provide support? If so, how? Are there past examples? Was the phenomenal improvement of our agricultural productivity one such example? Might the future development and use of the nation's integrated energy resources be another? What might be other candidates? How should we proceed?

Conclusion

It is difficult to see how significant strides could be made in any of these directions without the renaissance mentioned earlier. This has two parts. The first concerns the adaptability and responsiveness of the scientific/technical community to the needs of society. The second has to do with improved coalitions among government, industry, and labor, vis-a-vis better selected markets, so that science and technology could be better used in the interest of us all.

In the meantime, decisions will continue to be based primarily on political, fiscal, and other special considerations, with insufficient examination of substantive alternatives and consequences in terms of "opportunity costs" and "marginal utilities", when these are viewed in the broadest possible social, political, economic, technical, and institutional contexts.

Parlaying the Benefits of Federal R&D

In the past few years, the expressions "technology utilization" and "technology transfer" have appeared with increasing frequency. More and more, Government agencies are recognizing the desirability of establishing machinery for translating their research findings into useful products, processes, or programs that fulfill public or private needs beyond the original purpose of the research.

In a speech last September, Dr. M. Frank Hersman, Director of the National Science Foundation's Office of Intergovernmental Science and Research Utilization, reviewed the steps being taken toward the development of a national technology transfer and utilization policy. His talk, reproduced below, emphasizes the need for special efforts by the research community to work toward technology utilization.

His discussion deals primarily with the Federal role (and particularly the NSF's) in promoting technology utilization. Yet, says Dr. Hersman, the desired impacts of technology on domestic problems cannot be brought about "unless state and local government, private industry, and the academic community [also] focus their attention on the utilization phase of R&D."

TECHNOLOGY UTILIZATION IN THE PUBLIC SECTOR

by M. Frank Hersman

Introduction

The role of the Federal Government as a producer of technology is generally accepted. More than half of the research conducted in the United States last year – over 28 billion dollars – was funded by the Federal Government,[1]* although most of it is performed by private industry (over 70 percent) or academic and nonprofit institutions (11 percent). Only 17 percent of the R&D is performed by Federal Government agencies or laboratories.

Despite this large Federal investment in research and development (R&D), there have been, until recently, only sporadic efforts to achieve technological transfer and utilization. No coherent national policy has emerged for deriving the maximum possible benefits from the technological innovations produced by Federally funded R&D, particularly in bettering the social, economic, and environmental aspects of national life. In the last few years, however, there has been a growing awareness of the need for such a policy. This paper provides an overview on what is being done to develop a national technology transfer and utilization policy. A working definition of technology utilization will be proposed and existing mechanisms and procedures for technology transfer will be reviewed. Particular emphasis will be placed on the policies and programs of the National Science Foundation, including those additional responsibilities assigned in the President's Message on Science and Technology in March, 1972.

Technology Transfer and Utilization

Industry operates on the principle that R&D of itself is not enough. The end results of research must be put to work. For the most part, therefore, industry has a system which integrates R&D with engineering, testing, manufacturing, and sales. Such an integrated and coordinated system does not exist in the Government sector, except possibly for agriculture and technological products used directly by the Federal establishment – primarily in the space and national security fields.

Before exploring what the Federal Government is or is not doing now to promote technology transfer and utilization, some exploration of the meaning of these terms is necessary. Originally, "technology

* All footnotes will appear at the end of this article.

transfer" meant the use of technology developed for one purpose in performing a different function. Today, however, the term tends to have a more restricted meaning: the reuse of materials, processes, or equipment developed *with Government support* for some national purpose in order to achieve new public or private ends.

Within this framework, a number of alternative meanings to the term "technology transfer" have emerged. These relate to the ends sought in the transfer process. These can be illustrated by the following questions, each of which implies different approaches to policy and program development ranging over a broad spectrum:

- Is technology transferred when a recipient of technical knowledge performs feasibility studies and/or trial applications and evaluations?
- Is technology transferred when there is a single acceptance and operational application of a new technology?
- Or, is technology transferred when there are multiple applications of operationally useful processes and products (i.e., a market created or a problem solved) through the process of replication and diffusion?

In general, it is the third process to which the new concern with technology transfer is addressing itself. To distinguish this process from the first two, it is perhaps better to speak of "technology utilization" when considering Federal policy on technology transfer. For the purposes of this paper, therefore, *technology utilization will be considered the process by which existing research knowledge is translated operationally into useful processes, products, or programs which fulfill actual or potential public or private needs.*

The characteristic of successful technology utilization, therefore, is that it is technically, economically, and institutionally feasible on a broad scale. The choice of this definition has one important limitation: the "success rate", initially, is likely to be extremely low. Conversely, if transfer is defined to mean merely the dissemination of information or expansion of knowledge, the probability of success is much greater. In the following discussion of Federal transfer mechanisms and programs, these distinctions must be kept in mind in analyzing the purposes and degree or success, or lack of same.

Existing Policies for Promoting Technology Utilization

The agricultural research and extension system is the earliest form of explicit Federal policy, program, and funding for technology utilization.[2] The beginnings of an active Federal role in promoting the application of knowledge to improve farming methods can be traced as far back as 1862 to the passage of the Land-Grant College Act by which the states were enabled to support the development of agricultural and mechanical colleges. In 1887, the Hatch Experiment Station Act established agricultural experiment stations throughout the country.

Nevertheless, by the beginning of the twentieth century many farmers had not adopted the new techniques and new varieties of products which colleges and experiment stations had developed. It was not until the formal establishment of the county agent system in 1914 that the new agriculture knowledge passed to the stage of technology utilization. Today the U. S. Agriculture Department's research and extension system is generally considered a leading example in this country of technology generation, transfer, and use.

Unfortunately, no other Federal agencies have such explicit policies and mechanisms for promoting technology transfer written into their enabling legislation. A few, however, have general mandates to perform transfer functions, but these usually fall short of the utilization stage.

The Atomic Energy Act of 1954, for instance, provides for making available to industry the results of AEC research, development, and industrial operations.[3] The Space Act of 1958 charged NASA to "provide for the widest practicable and appropriate dissemin-

ation of information concerning its activities and the results thereof."[4] Title IX of the National Defense Education Act of 1958 charged the National Science Foundation with the role of disseminating scientific information, including the development of new or improved methods for making scientific information available.[5] Section 9B of the Small Business Act makes it Federal policy to help small business concerns obtain the benefits of research and development performed under Government contracts or at Government expense.[6]

Other agencies have an implicit policy for promoting technology utilization. The recently restated mission of the Department of Commerce includes the fostering of the national economic development and technological advancement.[7] The Department of Interior and the Department of Housing and Urban Development have identifiable but varying efforts for disseminating R&D to the private sector.

Emerging Framework for a Federal Policy

Apart from the trend over the years to charge individual departments with technology transfer functions, there has been, within the past year, increasing attention paid to the need for defining a national policy on technology utilization. Some of the more significant statements and reports in this regard have included:

(1) The President's Message to Congress on Science and Technology (March 16, 1972) which stated: "Federal research and development activities generate a great deal of new technology which could be applied in ways which go well beyond the immediate mission of the supporting agency. In such cases, I believe, the Government has a responsibility to transfer the results of its research and development activities to wider use in the private sector."[8]

(2) The report of the Committee on Intergovernmental Science Relations to the Federal Council on Science and Technology (May, 1972), which urges policies and mechanisms to increase the capacity of state and local governments for the task of utilizing Federally developed technology and to participate in formulating national R&D priorities.[9] The Committee's recommendations[10] are directed chiefly toward the implementation of a balanced intergovernmental R&D effort through "flexible arrangements that can facilitate the transfer of science and technology among Federal, state, and local government units and the people they serve."[11]

(3) The policy recommendation of the Federal Council on Science and Technology for Expanded Interagency Cooperation in the use of Federal laboratories which received general support from the Office of Management and Budget.[12] This proposed policy would charge existing Federal R&D agencies, consistent with existing laws and established relationships with industry, universities, and nonprofit institutions, with utilizing their resources to define and solve technological problems and to guide the technical content of policy decisions relating to such urgent national needs as environment, pollution, transportation and the like.[13]

(4) The General Accounting Office (GAO) (March 2, 1972)[14] which recommended (a) a Government-wide policy for technology transfer with guidelines issued to Federal agencies to implement a formal, active technology transfer process, (b) the Secretary of Defense establish policy and procedures to encourage more extensive application of existing defense technology to civilian problems, and (c) the establishment of a technology transfer consulting team as a central focus to assist Federal agencies in the matching of technological resources with pressing national needs.

Approaches Toward Technology Utilization

Despite these manifestations of executive branch and congressional interest in the development of technology transfer policy, the efforts of Federal agencies in this field are still tailored to the basic mission of each agency, the nature of the technology it de-

velops, its perceptions of the identity and needs of the client users, and the resources available.

Nevertheless, the efforts of individual agencies at technology transfer have resulted in many and varied instances of utilization with substantial benefits to society. The space program, for instance, has produced weather and communications satellites, and the atomic energy program has produced a civilian nuclear power industry and a number of applications of radioisotopes and radiation in medicine, industry, agriculture, and biomedical research. These are but a few of the better known examples from what could be an extended list. The main purpose of this paper is not to detail the benefits from technology utilization but rather to illuminate the different approaches which have been employed by Federal agencies to achieve these benefits.

Typologies of Existing Programs for Technology Utilization

Existing mechanisms directed toward technology utilization can be categorized into four groups: clearinghouse, communication, training, and change agents. The first two mechanisms are common to virtually all programs. Examples of clearinghouses are the Educational Resources Information Center (ERIC) of the Office of Education, the regional dissemination centers of NASA, the National Technical Information Service of the Commerce Department, the Smithsonian Science Information Exchange, and the National Referral Center of the Library of Congress.

The clearninghouse function is essentially passive in nature. Where Federal agencies use communications media, the documentation and dissemination process becomes more active. Examples would include the Research and Demonstration BRIEF issued by the Research Utilization Branch of the Social and Rehabilitation Service of HEW. BRIEF, an acronym for Bring Research into Effective Focus, is a one-sheet, two-page roundup of a completed research project intended for practitioners. Similar approaches are used by the Small Business Administration in its "Tech Aids" series and in the joint AEC-NASA publication, "TECH BRIEFS."

More active yet, are the training activities of a number of agencies which include conferences, workshops, courses, and manuals. The AEC, for instance, has an education program to broaden the manpower base of nuclear technology. The Department of HUD has sponsored conferences and workshops on technologically advanced systems for producing housing. The EPA, in an effort to prevent investments in obsolete municipal waste water treatment and control facilities, issues manuals on newly developed technology which are distributed to engineers involved in the design and construction of such facilities.

The most active approach is through the use of change agents such as the extension-service county-agent system of the Agriculture Department. The use of change agents without direct backup is part of SBA's program and was employed in the short-lived State Technical Services Program of the Department of Commerce.

In addition to the four basic approaches described above, a fifth is emerging: personnel mobility. With the passage of the Intergovernment Cooperation Act of 1970, exchange of personnel between Federal Government and state and local government as well as universities, an additional opportunity exists for technology transfer. To date, however, only 243 assignments have been made[15] and few of them could be classified as directly related to technology utilization objectives.

Technology Utilization and the National Science Foundation

The legislation creating the National Science Foundation in 1950 directed the Foundation to promote "basic research and education in science"[16] and to "support basic research in the mathematical, physical, medical, biological, engineering, and other sciences".[17] Initial concentration in the physical and life sciences eventually broad-

ened to include the social sciences. Research utilization at NSF in the early years was the process by which research results were either incorporated into further basic research in the same field or served as the basis for some applied research activities. Generally the process of scientific inquiry is such that the results of one man's investigations are eagerly watched by others in the same discipline and results are rapidly disseminated throughout the community even in advance of publication in the scientific literature. Hence, no separate NSF programs of research utilization were deemed necessary or desirable.

The legislative mandate of the National Science Foundation was expanded in 1968 to include support of research directly related to the problems of society.[18] This expanded authority, coupled with experience previously gained from problem-oriented research, has led the Foundation to engage more directly in focusing research on selected environmental and social problems and on the potential impacts of future technological developments. The program under which this problem-focused research is conducted is called Research Applied to National Needs (RANN). The emphasis on societal problems gives RANN a strong user-orienation which is an essential element for a successful technology transfer and utilization program.

Activities supported by RANN seek to increase understanding of social and environmental problems and their underlying causes and to identify opportunities and means for applying advanced technology for the benefit of society. The scopes of the problems being investigated include social data and community structure, weather modification and the environmental aspects of trace contaminants, and earthquate engineering and excavation technology. Under the RANN programs the users and producers of knowledge do not share the same objectives or operate in the same environments as in the case of basic research and, therefore, a separate bridging process of research utilization is necessary. In order to facilitate the transfer and utilization of the RANN research, a separate utilization plan is cooperatively developed, with the researchers under each project as an integral part of the grant management process. In addition, the Office of Intergovernmental Science and Research Utilization (ISRU) recently has been charged with responsibility of facilitating RANN research utilization. The RANN research utilization functions of this Office reinforce and complement the ongoing inter-Governmental grant activities.

The Intergovernmental Science Programs of the Office of Intergovernmental Science and Research Utilization foster the capacity and capability of state and local governments to develop new and improved institutions and mechanisms for the systematic application of science and technology to Governmental problems. As such, states and their political subdivisions will be able to utilize better the RANN research findings as well as other products and processes of public technology. Under this program, NSF is strongly committed to technology utilization in the public sector.

Since its inception, the Intergovernmental Science Programs has supported almost 100 projects to assist states and their political subdivisions. This has involved over 2-1/2 million dollars in grants to Governmental agencies, academic institutions, research institutions, and nonprofit associations and organizations. The supported projects in the past can be divided into two basic modes: (1) publications, workshops, and conferences directed at increasing Governmental awareness and understanding of the potential of science and technology in decision-making and program operations and (2) analytical studies and experiment or demonstration projects directed at identifying and testing alternative approaches for institutional change to enhance the capability of state and local governments more effectively to use public technology.

A number of strategies for fostering institutional changes have been funded, and these tend to fall into four broad categories that describe the source or location of the transfer mechanism or "brokerage" func-

tion: the organization management mechanism within the Governmental structure, the advisory-group mechanism external to the formal structure of Government, the university extension or public service mechanism, and the industry-Government coupling mechanism.

Under the organizational management category, attempts are being made to improve institutional capacity and capability itself by supporting projects at the state and local level involving both the executive and legislative branches of government. For example, in the City of Tacoma, Washington, support is being given to the Office of the City Manager for full-time staff assistance to integrate technological innovations into city operations using actual problem-solving approaches.[19] The Office of the Speaker of the Assembly of the State of New York has been given a grant to establish an Assembly scientific staff, a novel legislative mechanism to facilitate the application of science and technology to legislative issues.[20] In both cases a core management organization has been established in the Government units, which has funds to develop partnership programs with industry, and with academic, professional, and nonprofit groups.

The advisory group mechanism had been the most common strategy for science and technology assistance at the state and local levels through such approaches as state science advisors and/or governor's science advisory committees. The Foundation currently is supporting the establishment of a Council of Economic Advisors to the State of Minnesota[21] and a Science and Technology Advisory Council for the City of Philadelphia.[22]

Under the public service mechanism, projects range from the placement of individual interns within Governmental agencies to an experimental technical field-service program. In Massachusetts, upper-level and graduate-school interns are being placed with individual program managers in one line department to undertake applied research projects to help Governmental problem solving.[23] In Pennsylvania, an experimental project is being undertaken to extend to local governments the technical services of a university-based (Penn State), technology applications program (called PENNTAP);[24] the program is modeled in part on the agricultural extension system. Faculty-student teams from Auburn University[25] and Oklahoma State University[26] are applying interdisciplinary university resources to specific city and county problems chosen by mutual agreement with the governmental officials.

The industry-government coupling mechanism may be particularly appropriate at the local levels of government, especially if aerospace technology and capability can assist in meeting technology-related problems and in city management itself. The National Science Foundation is funding a demonstration project jointly with NASA to evaluate the effectiveness of placing senior industrial aerospace personnel in key positions in four city governments in California with the full backup resource of one aerospace company for each city.[27]

In all of the above examples, the Intergovernmental Science Programs has been supporting change agents within or external to the government structure but fostering appropriate institutional or procedural changes within that structure. As noted previously, the use of change agents is one of the major typologies for technology utilization. One of the other categories noted was personnel mobility. Both the Foundation as a whole and its Office of Intergovernmental Science and Research Utilization has made full use of this approach. Throughout most of its history, NSF has utilized the capability and experience of the academic community for 1-year assignments to lead offices and manager programs. Two of the program managers of the small Office of Intergovernmental Science and Research Utilization are on mobility assignments to the Foundation from state and local governments.

Another program manager in the Office is on detail from a Department of Defense Research and Engineering Laboratory to assist in developing a strategy for the use of

the DOD and other Federal laboratories both to undertake RANN research activities and to meet state and local R&D needs.

The Utilization Program for promoting RANN research is the second component of the Office of Intergovernmental Science and Research Utilization. Although only in the process of being formulated, certain strategies and activities have begun to materialize. Program managers recently have been added whose sole responsibility is to facilitate the utilization of RANN research among primary users and to help shape dissemination and diffusion programs for dispensing results to secondary users. Recognizing that the best utilization programs are those aimed at sharply felt needs, these program managers are responsible in part also for defining user needs and in ensuring that these needs are fully reflected in RANN-supported research activities. At this point, it is the intent of the Foundation to limit the Office staff and to rely heavily on outside contractors for monitoring RANN utilization activities.

Not all the utilization functions of the National Science Foundation are undertaken in or by the Office of Intergovernmental Science and Research Utilization. The Office of Science Information Service, for example, has major responsibility for fostering activities that fall into two of the categories of existing mechanisms for technology utilization: clearinghouse and communication. This Office provides leadership in the development and improvement of science communication, the scope of which has grown and broadened over the last 25 years. The Office of Science Information Service supports also the design and development of improved primary and specialized publications, of literature-based information systems, and of computerized systems for quantitative and factual data — all related to science and technology for information-transfer purposes. Moreover, this Office chairs, provides executive secretariat support to, and undertakes management responsibility for, the Committee on Scientific and Technical Information (COSATI) of the Federal Council on Science and Technology (FCST). COSATI is a standing committee of FCST, whose objectives are to coordinate scientific and technical information programs of Federal agencies and to foster development of national systems for information transfer. Thus, it can be seen that the National Science Foundation is involved in many of its offices and programs in technology utilization.

Conclusions and Future Directions

One estimate or the effectiveness of Federal programs for technology utilization states:

> The existing efforts by Government agencies to transfer technology to industry are fragmented, weakly coordinated, sometimes overlapping, not well known or utilized by industry, and generally at a level of effort substantially below that preferred for reasonable effectiveness.[28]

An overall formal policy at the Executive Office level is lacking to guide Federal agencies merely in the dissemination of scientific and technical information. An analysis of existing policies and programs would show:

- Few agencies have specific policies covering technology utilization or specific offices or individuals to coordinate this activity.
- While most agencies have programs for reporting the results of scientific research, only two systematically report, evaluate, package, and disseminate in other ways their technology output.
- Very few agencies have a specific policy to urge their personnel or contractors to search the existing literature and take other steps to identify and use relevant existing technology prior to undertaking new R&D, although individual researchers clearly are free to pursue their own choice of research methodology.
- Many non-Federal channels, such as trade and professional publications and societies and government interest groups tend to be underutilized by most agencies.
- Some Government-generated technology

of potential use in the public sector as well as to industry and education currently is unavailable because of administrative or security restrictions.

Despite the shortcomings, there are some hopeful signs. The issue of technology utilization is finally coming into focus in the Federal Government. Follow-up action on both the President's Message and the report of the Committee on Intergovernmental Science Relations to the Federal Council on Science and Technology has begun. An ad-hoc Inter-agency Committee on State and Local Technology Sharing has been convened by the Office of Science and Technology (OST) of the Executive Office of the President. The goal of this committee, headed by Dr. Billy Caldwell of OST and consisting of all the major R&D support agencies, is

> . . . to develop an effective communication and coordination system within and among departments and agencies for those activities that relate to state and local governments, and to evaluate current R&D, technology assistance and transfer programs of the departments and agencies.[29]

Two additional programs are being initiated in the National Science Foundation during fiscal 1973 year, both of which were highlighted in the President's State of the Union Message in January of 1972. Both of these have a major bearing on, and could benefit from, the participation of private industry and universities.

The first is the Experimental R&D Incentives Program. Through carefully controlled experiments this program will attempt to find incentives which can increase non-Federal investments and participation in R&D and can better encourage applications which improve economic growth and productivity or lead to the solution of societal problems. The program also will attempt to find incentives for joint research between universities and industry as well as the exchange of skilled professional and technical personnel.

The other outgrowth of the President's 1972 State of the Union Message is the National R&D Assessment Program. How science and technology contribute to national goals and objectives, including improvement in the quality of life, job creation, and economic growth, will be the subject of intensive study. Through this program, NSF will analyze overall national R&D patterns; the incentive structures and decision points that have produced existing patterns for support, performance, and utilization of R&D in industry, government, nonprofit institutions, and universities; and the implications that the choice of options will have in shaping future R&D patterns.

This report has focused primarily on the Federal role in promoting technology utilization. Yet unless state and local government, private industry, and the academic community focus their attention on the utilization phase of R&D, no amount of dissemination, communication, training, or change agents will bring about the desired impacts of technology on domestic problems.

The President's Message on Science and Technology specifically charged his Science Adviser, in cooperation with the Office of Intergovernmental Relations, to serve as a focal point for discussions among various Federal agencies and the representatives of state and local governments. These discussions, the Message said, should focus on the following specific subjects:

(1) Systematic ways for communicating to the appropriate Federal agencies the priority needs of state and local governments, along with information concerning locally generated solutions to such problems. In this way, such information can be incorporated into the Federal research and development planning process.

(2) Ways of assuring state and local governments adequate access to the technical resources of major Federal research and development centers, such as those which are concerned with transportation, the environment, and the development of new sources of energy.

(3) Methods whereby the Federal Government can encourage the aggregation of state and local markets for certain products so that industries can give Government purchasers the benefits of innovation and economies of scale.[30]

Thus, future Federal policy on technology transfer is being directed toward opportunities for utilization. The R&D community should recognize that in this change of direction, the new approach increasingly is going to favor those who can act as "science brokers" — to put existing knowledge to work. This does not mean that basic and applied research will halt. Utilization strategy requires, however, that some of the stimuli for research come from a lively interest in the current problems of society.

This lively interest must arise at all levels of government and industry. It may take the form of personal involvement of scientists and engineers in the communities and states where they live, whether on a salaried basis, as in the four-cities program, or on a volunteer basis. It may require a readiness to mobilize special task forces which pool the resources of several states, communities, or industries to attack a specific problem such as solid waste removal or recycling.

No one strategy for successful technology utilization is likely to emerge. For this reason, innovation and flexibility will be required in the mechanisms, institutions, and processes dealing with transfer problems. As a general rule, however, technology utilization will be most successful when the potential users of the technology are part of the problem-solving process beginning with the identification of user needs and ending with the utilization of the research and development of output to satisfy these needs.

As experience is gained in pilot and multiple technology applications, the knowledge about utilization itself can be transferred. As an initial start in developing this body of knowledge, the Office of Intergovernmental Science and Research Utilization of NSF intends to fund analytical studies on the process of innovation in the public sector and the preparation of detailed case studies on actual technology transfer to state and local governments.

In the meantime, the satisfaction of the pressing needs of society, whether it be adequate housing, clean air and water, or better delivery of health services, will depend, to a great degree, on the ingenuity shown by the research community in adapting its work to the challenging process of technology utilization.

FOOTNOTES:

1. Data in the paragraph are from the following two publications:
   a. National Science Foundation, Research and Development in Industry, 1970, NSF 72-309 (Washington, D. C., Supt. of Documents, U.S. Government Printing Office, 1972)
   b. National Science Foundation, "Federal R&D Funding Continues to Rise", Science Resources Studies Highlights, NSF 72-314, 11 August 1972.
2. Information in this paragraph is drawn mainly from the chapter "A Brief History of American Agriculture" by Dr. Wayne D. Rasmussen, Historian, Economic Research Service, U. S. Department of Agriculture, appearing in: Committee on Agriculture, U. S. House of Representatives, 89th Congress, Second Session, Men and Milestones in American Agriculture (Washington, D. C., Committee Print, U. S. Government Printing Office, 1966).
3. Atomic Energy Act of 1954, as amended; P.L. 83-703.
4. National Aeronautics and Space Act of 1958, as amended; P.L. 85-568.
5. National Defense Education Act of 1958, as amended; P.L. 85-864.
6. Small Business Act, as amended; P.L. 85-536.
7. U. S. Department of Commerce, Serving a Growing Economy and a Growing People (Washington, D. C., U. S. Government Printing Office, 1970), p. 5.

8. Nixon, Richard M., Science and Technology, The President's Message to Congress, March 16, 1972, Weekly Compilation of Presidential Documents, March 20, 1972 (Washington, D. C., U. S. Government Printing Office, 1972), p. 5.

9. Committee on Intergovernmental Science Relations to the Federal Council for Science and Technology (FCST), Public Technology: A Tool for Solving National Problems (Washington, D. C., Supt. of Documents, U. S. Government Printing Office), p. 1.

10. The first three policy recommendations are as follows:
    "1. The Federal Government seek and incorporate the views of state and local governments in the formulation of those aspects of national science and technology policy related to state and local requirements and problems.
    2. Federal agencies seek to identify science and technology applications of their research and development programs which could be useful to state and local governments.
    3. The Federal Government actively undertake to disseminate to state and local governments the scientific and technological knowledge which it develops related to the needs of these levels of government."
    Ibid., p. 5.

11. Ibid., p. 4.

12. Carlucci, Frank, Deputy Director, Office of Management and Budget (OMB), memorandum of 23 June 1972 to Dr. Edward E. David, Jr., Chairman, FCST.

13. David, Dr. Edward E. Jr., Chairman, FCST, memorandum of 1 March 1972 to The Honorable George P. Schultz, Director, OMB.

14. U. S. General Accounting Office, Means for Increasing the Use of Defense Technology to Meet Urgent National Needs, A Report to the Congress by the Comptroller General of the United States, 2 March 1972 (Washington, D. C., U. S. Government Printing Office, 1972).

15. Advisory Commission on Intergovernmental Relations, "Intergovernmental Talent Sharing – IPA's Mobility Program is One Year Old", Information Bulletin, No. 72-6 (Washington, D. C., The Commission, 10 July 1972), p. 3.

16. National Science Act of 1950, as amended; P.L. 81-507, Section 3(a) (1).

17. Ibid., Section 3(a) (2).

18. National Science Act of 1968, P.L. 90-407.

19. NSF Grant GT-34903.
20. NSF Grant GT-32162.
21. NSF Grant GT-45935.
22. NSF Grant GT-34579.
23. NSF Grant GT-32.
24. NSF Grant GT-35010.
25. NSF Grant GT-34795.
26. NSF Grant GR 34670.
27. NSF Contract CA-58.

28. Beckler, David, Executive Assistant to the Director, Office of Science and Technology, draft Memorandum to Members, U. S. Science and Technology Policy Task Group III-2, FCST Ad-Hoc Committee on International Transfer of Technology, 8 December 1971, p. 20.

29. Caldwell, Dr. Billy E., Chairman, Ad-Hoc Interagency Committee on State and Local Technology Sharing, Memorandum to Members, 15 August 1972, p. 1.

30. Nixon, Richard M., Science and Technology, The President's Message to Congress, March 16, 1972, Weekly Compilation of Presidential Documents, March 20, 1972 (Washington, D.C., U.S. Government Printing Office, 1972), p. 8.

R&D in the Third World

"Advanced countries . . . should devote a significant share of their R&D resources and facilities to projects specifically related to problems of developing countries. They should encourage . . . the scientific potential of the LDC's [less developed countries] through aid, manpower training, and scientific/cultural exchanges."

So says Professor Mostafa H. Nagi, demographer, sociologist, researcher, and teacher at Bowling Green (Ohio) State University. Dr. Nagi holds degrees from Cairo University, Bowling Green, and the University of Connecticut. His teaching experience includes both graduate and undergraduate courses on the problems of developing nations.

In this paper, Dr. Nagi documents the desirability of fostering scientific capabilities in the less developed countries and outlines some of the obstacles they face. His conclusion: The gap between the R&D capabilities of the advanced countries and of the LDC's is beginning to narrow, but the LDC's still need lots of help and encouragement.

POLICIES ON SCIENCE AND TECHNOLOGY IN DEVELOPING COUNTRIES: RESEARCH AND DEVELOPMENT

By Mostafa H. Nagi

Science Policy Criteria

UNESCO defines science policy[1*] as "The Sum of legislative and executive measures taken to increase, organize, and use the national scientific and technological potential, with the object of achieving the country's overall development aims and enhancing its position in the world".

Few developed countries, if any, have a clear science policy. Rather, they have an agglomerate of many science and technology policies, more or less coordinated at the center. This is an inevitable result of the large number of controlling forces at play. In the less developed countries (LDC's), a coherent science policy is probably more feasible and almost certainly more necessary because of the financial control of scientific activities and of economic development by governments.[2]

In the now advanced countries, lack of science policy did not delay efforts to advance science and technology. But in light of the scarcity of resources of all types in the LDC's, the advance of a country's scientific and technological effort is likely to proceed more efficiently and wisely if such a policy exists. It is, therefore, wise to look carefully into the present efforts of the LDC's in order to ascertain the types of strategies they develop for promoting science and technology.

Specific recommendations for an effective science policy abound.[1-5] However, each nation has to develop its own policy according to its national goals and unique set of priorities. Whichever route may be chosen, "the policy-maker must make every decision in anxious awareness that to have a well-

1. The Application of Science and Technology to the Development of Asia: Basic Data and Considerations, SC/CASTASIA$_3$, Unesco, 8 May 1968.

2. Jones, G., The Role of Science & Technology in Developing Countries, International Council of Scientific Unions, Oxford University Press, London, England, 1971.

3. Riley, H. E., "Research in Technology: Where We Stand and What Needs to be Done", in Proceedings of a Conference on Technology Transfer and Innovation, National Science Foundation Report NSF 67-5, 1966, pp. 81-94.

4. Chagas, C., "Science and Technology in Latin America", in Government, Science, and International Policy, a compilation of papers prepared for the 8th Meeting of the Panel on Science and Technology, U. S. House of Representatives, 1967, pp. 7-21.

5. Baronson, J., "National Programs for Science and Technology in the Underdeveloped Areas", Bulletin of the Atomic Scientists, v. 16, 1969, pp. 151-154.

developed twentieth century policy in the twenty-first century will be to have an underdeveloped policy".[6]

The United Nations' Advisory Committee for the Application of Science and Technology to Development[7] articulated four fundamental obstacles to the development of science and technology in the LDC's. These are:

(1) The weakness of scientific institutions in the LDC's

(2) The "weight" and orientation of advanced-country science and technology and its impact on the LDC's

(3) The problems of access by the LDC's to world science and technology

(4) The obstacles to the application of new technologies arising from underdevelopment itself.

Institutions dealing with science and technology are relatively new to developing countries. These include: (a) policy-making organizations, (b) educational institutions, (c) research and development organizations, and (d) supporting scientific and technical service groups.

The Role of R&D

R&D is concerned with the increase of knowledge and the adaptation or invention of products or processes. "R&D is only part of the total innovation process, and it is not in itself a cause of economic growth. . . . R&D is but the first stage in the process, and the importance is now recognized of a continuous innovative chain linking scientific research, marketing research, invention, development, design, tooling, first production, and marketing of the new products".[2]

Research, advanced development, basic invention	5–10%
Engineering and designing the product	10–20%
Tooling, manufacturing, engineering (getting ready for manufacture)	40–50%
Manufacturing start-up expenses	5–15%
Marketing start-up expenses	10–25%

FIGURE 1. TYPICAL DISTRIBUTION OF COSTS IN SUCCESSFUL PRODUCT INNOVATIONS[8]

Figure 1 puts R&D in its proper perspective. As can be seen, R&D's share in the total expense of innovation is quite small. This emphasizes the importance of developing strength in all links of the chain in order that the research bear practical applications for the welfare of the country.[8]

Technological Balance of Payments

Figure 2 presents crude estimates of the technological balance of payments for countries outside of the Socialist block. (Technological balance of payments compares a country's payments to its receipts of technical know-how, licenses, and patents.) These estimates reveal another dimension of the gap between the rich and the poor countries. The advanced countries' technological receipts were about 99 percent of the world total in 1964, while the LDC's share was barely 1.9 percent.

The United States' dominant position in the world of technology in 1964 is quite clear

6. Waldo, D., Planning and Administration for Viable Policies: The Perspective of Official Responsibility, Claire Nadar (Ed.), Cambridge University Press, London, England, 1969.

7. United Nations Secretary General, Science and Technology for Development, United Nations, New York, N. Y., 1963, Vol. 7.

8. Charpie, R. A., Technological Innovation – Its Environment and Management, U. S. Department of Commerce, 1967, 83 pp.

Receipts, % of world total[a]		Payments, % of world total[a]	
U.S.A.	57%	U.S.A.	12%
U.K.	12%	U.K.	11%
Germany (F.R.)	6%	Germany (F.R.)	14%
France	5%	France	11%
Other Western European countries	18%	Other Western European countries	25%
Japan	1%	Japan	13%
Other developed countries	1%	Other developed countries	6%
Developing countries	1%[b]	Developing countries	8%

(a) Excluding transactions among socialist countries and between those countries and developing countries.

(b) Receipts of developing countries were negligible and in any case were less than 1 percent.

FIGURE 2. TECHNOLOGICAL BALANCE OF PAYMENTS: ESTIMATES FOR 1964[9]

from this country's share of well over half of the world receipts (57 percent). Furthermore, as of 1964, all developed and LDC's, with the exception of the United States and possibly the United Kingdom, had adverse technological balances of payments. This means that few countries, developed or not, can rely only on their internal technical discoveries. "In general, it would seem that any country, even the United States and the U.S.S.R., must buy technology from abroad".[2] For the LDC's, this seems to be a wise use of resources, since their technological capabilities are low to begin with, and since high investments are necessary for full use of the latest scientific research.

The LDC's are being advised to concentrate on the transfer of technology from the advanced countries in the early stages of their development. But the transfer of technology, though necessary, is not an alternative to the development of local science. Furthermore, the LDC's must have some scientific capability, if only to choose the most suitable technology for transfer. Also, scientific capabilities will be needed for adaptation and modification of imported technologies.

This is particularly so since advanced countries place little emphasis on solving the technological problems of the LDC's; many spend R&D resources searching for synthetic

9. Oldham, C.D.G., Freeman, C., and Turkcan, E., Transfer of Technology to Developing Countries, Study of the Science Policy Research Unit of the University of Sussex, for the U.N. Conference on Trade and Development, Second Session, TD/28/Supp. 1, 10 November 1967.

substitutes for the LDC's exports.

Expenditures on R&D

Expenditures on R&D require a gestation period until the results are commercially exploited through innovation. The effect of R&D expenditures on the growth rate of the economy is as yet to be determined, but it has been found[10] that the percentage of GNP spent on R&D is poorly correlated with the growth rate of the GNP in some industrial states. This apparent lack of correlation may be related to the fact that R&D is but a part of the innovative process. It may also be related to the fact that a great portion of R&D expenditures in some Western countries is dedicated to defense and space research, which may or may not provide spinoff that can be used for civilian purposes.[2]

In spite of many limitations[11], available statistics on the R&D activities in various countries can help us to ascertain general trends. These statistics pertain only to R&D and could not be considered an accurate picture of a country's overall scientific and technological efforts.

Although there is yet no accurate method for deflating R&D expenditures to allow for wage and price increases, a careful examination of the most recent statistics available can be useful.

The following can be ascertained from the comparative figures in Table 1:

(1) The highly industrialized societies (U.S.A., U.S.S.R., Japan, United Kingdom, and France) spend a far greater percentage of their GNP on R&D than do the LDC's. The latter generally spend less than 1 percent of their GNP on R&D.

TABLE 1. RESEARCH AND DEVELOPMENT EXPENDITURES AS A PERCENTAGE OF GNP: LESS DEVELOPED COUNTRIES COMPARED WITH SEVERAL ADVANCED COUNTRIES

Country	Year	Percentage of GNP
Czechoslovakia	1969	3.1[a]
U.S.S.R.	1969	3.5[a]
U.S.A.	1968	3.0[b]
Hungary	1969	2.6[a]
United Kingdom	1967	2.3[c]
Zambia	1969	2.1[a]
France	1967	2.0
Japan	1968	1.7
Cuba	1965	1.2[d]
Botswana	1968	1.0[a,d,e]
Argentina	1965	0.9[a,d,e,f]
Honduras	1965	0.8[a,d,e]
Madagascar	1969	0.7[a,g]
Bolivia	1967	0.6[a,d,e]
Ivory Coast	1967	0.6[a,d,e]
Korea, Republic of	1969	0.5
Nigeria	1966	0.5[a,d,e,h]
Cyprus	1968	0.4[a]
Taiwan	1966	0.4[a,d,e]
India	1969	0.4[a,d,i]
Turkey	1969	0.3[a]
Thailand	1968	0.3[a]
Sudan	1966	0.2[a,d,e]
British Honduras	1965	0.2[a,d,e,h,j]
Philippines	1965	0.2[d,e]
Ceylon	1968	0.2
Cameroon	1967	0.2[a]
Mauritius and Dependents	1967	0.2[a]
Kenya	1966	0.1[d,e,k]
Mexico	1966	0.1[d,e,k]
Venezuela	1964	0.1[a,d,e]

[a] Estimate
[d] As percentage of net material product
[e] Not including capital expenditure for productive enterprise sector
[f] Not including data for social sciences
[g] Refers to current expenditures only
[h] Not including data for production enterprise sector
[i] As percentage of gross domestic product at market prices
[k] Data relate to general government sector only
[m] Data relate to higher education sector only

Source: UNESCO Statistical Yearbook, 1970, pp. xxx-xxx

(2) There is a great difference among LDC's in the percentage of GNP spent on R&D. Compare, for example, Cuba which spends 1.2 percent of its GNP on R&D with Venezuela, which spends only 0.1 percent.

(3) The Communist countries (Czechoslovakia, U.S.S.R., Hungary, and Cuba) spend a relatively larger portion of their GNP on R&D, in comparison with both developed and LDC's.

An examination of the average rates of growth in current expenditures for R&D in the LDC's would provide a clearer picture of current efforts to increase the science and technology capabilities of

10. Blackett, P.M.S., "Science and Technology", Development Digest, v. 3, 1970, pp. 73-76.

11. Shapely, W. H., Problems of Definition, Concept, and Interpretation of R&D Statistics, based on papers presented at a session of the American Statistical Association Meeting, National Science Foundation Report NSF 59-36, December 1958.

TABLE 2. AVERAGE RATES OF GROWTH IN CURRENT EXPENDITURE FOR RESEARCH AND DEVELOPMENT*

Country	Period	Average Rate of Growth, %	Average Annual GNP Growth Rate, %
Malawi	1965-68	60.0	
[illegible]	1964-65	15.0	[illegible]
Cambodia	1964-65	21.0	[illegible]
Cuba	1964-69	6.0	
Botswana	1967-68	17.0	
Cyprus	1962-67	11.7	
Korea, Republic of	1967-69	18.3	[illegible]
Pakistan	1961-65	16.0	[illegible]
Kuwait	1963-66	27.3	[illegible]
Hong Kong	1963-65	27.0	
Thailand	1961-65	25.1	[illegible]
Japan	1963-65	21.2	
Argentina	1962-63	19.3	[illegible]
Sudan	1963-66	15.0	[illegible]
Canada	1967-68	11.2	
India	1965-69	11.0	[illegible]
Togo	1963-67	11.0	[illegible]
Madagascar	1966-68	11.0	
U.S.S.R.	1965-66	9.2	
British Honduras	1962-63	9.0	
Taiwan	1961-67	7.0	
U.S.A.	1965-68[illegible]	5.6	
Guyana	1963-65	5.0	[illegible]
Surinam	1963-67	5.0	
Philippines	1963-65	5.5	[illegible]
Ghana	1963-65	5.0	
Jordan	1964-66	4.4	
Rwanda	1963-67	4.0	
Chad	1963-69	2.0	
Libya	1965-66	1.0	

[illegible] Statistical Yearbook, 1968, pp. [illegible]

a. Rate of growth for total expenditures

b. Calculated from data in pp. [illegible]

these countries.

As the figures in Table 2 indicate, many of the developing countries' expenditures on R&D are growing much faster than those of the more advanced countries. A number of the developing countries have surpassed the targets set by the United Nations' Advisory Committee for the Application of Science and Technology to Development, which proposed "that in the aggregate, the developing countries should aim to reach research and development expenditure levels of 0.5 percent of GNP by the end of the decade (1970). Given the assumption of an aggregate GNP growth rate of 6 percent per annum, this would imply an average annual increase of just over 15 percent in real expenditures for research and development over the decade". It is evident that the countries that have reached the 6 percent annual growth rate have exceeded the 15 percent figure in average annual increase.

Manpower Engaged in R&D

Some experts suggest[1] that observation of the allocation of human resources offers a more accurate picture of the real growth of R&D in relation to the rest of the economy; that allocation of manpower is the only accurate indicator of the input into the various sectors of economy engaged in R&D; and that it also serves as the only gage of the share of the R&D pie allocated to fundamental research, applied research, and development. Table 3 shows the number of personnel in research and development classified as scientists and engineers, or technicians.

Table 3 clearly shows the gap that exists between the advanced countries and the LDC's. The advanced countries allocate a far greater percentage of scientific human resources to research and development than do the LDC's. This situation reflects the general shortage of scientists, engineers, and technicians in many developing countries, and the fact that many of the ones they do have are employed in teaching positions in universities and higher institutions. The ratio of technicians to scientists serves as a rough indicator of the level of scientific training, as well as the degree of sophistication of R&D. Few of the LDC's in this table have a lower ratio of technicians to scientists than does the U.S.A., which is an indication of the lower level of scientific training in most of the LDC's.

For manpower purposes, UNESCO draws the line between scientifically advanced nations and developing nations at five individuals engaged in R&D per 10,000 population. Among the LDC's listed in Table 3, only Chile reaches that level.

The average rates of increase in numbers of personnel engaged in R&D in selected countries during the middle and late 1960's are presented in Table 4.

As these figures indicate, many of the developing countries are increasing their personnel engaged in R&D much faster than the highly advanced countries. This is a reflection of the current efforts on the part of the LDC's to enlarge their educa-

TABLE 3. PERSONNEL ENGAGED IN RESEARCH AND DEVELOPMENT*

Country	Year	Scientists and Engineers per 10,000 Population	Technicians per 10,000 Population	Number of Technicians per Scientists and Engineers
U.S.S.R.	1969	36.8	..	..
U.S.A.	1966	25.2	10.8[a]	0.4
Czechoslovakia	1969	24.9	39.7	1.6
St. Helena & Dependents	1966	22.0	24.0	1.1
Japan	1969	19.7	7.5	0.4
Germany, Federal Rep. of	1967	10.5	10.1	1.0
France	1967	10.2	14.7	1.4
Israel	1970	9.7++	..	..
Mongolia	1966	8.3++	..	..
United Kingdom[b,c]	1968	7.9	19.3	2.4
Chile	1969	4.9++	1.6++	0.3
Bhutan	1967	3.2	..	..
U.A.R.	1968	2.9	..	..
Turkey	1967	1.8++	..	..
Philippines[d,g]	1965	1.7	0.6[e]	0.4[e]
Zambia	1969	1.6++	3.6++	2.2
Cyprus	1969	1.5	1.9	1.2
Singapore	1966	1.3++	2.7++	2.0++
India	1968	1.2	..[f]	..
Korea, Rep. of	1969	1.2	0.6	0.5
Bolivia	1967	1.1	..	..
Lebanon	1967	1.0++	0.6++	0.6++
Bahrain	1967	0.6	0.2	0.2
Ivory Coast	1967	0.5	0.4	0.9
Malaysia	1966	0.4	1.2	2.9
Pakistan	1966	0.4++	..	..
Iraq[h]	1969	0.3++	0.0++	0.2
Madagascar	1969	0.3++,[d]	0.3++,[d]	0.9++
Mauritius and Dependents	1966	0.3	0.2	0.8
Nigeria	1969	0.3++	..	..
Botswana	1967	0.2	0.1	0.6
Ghana	1966	0.2	0.7	3.3
Jordan	1966	0.2	0.0	0.2
Cameroon	1967	0.1	0.3	1.8
Congo, People's Rep. of	1966	0.1	0.3	1.8
Rwanda	1967	0.1	0.0	0.4
Sudan	1966	0.1	0.1	1.7
Upper Volta	1967	0.1	0.1	0.7

*From UNESCO Statistical Yearbook, 1970, pp. 588-592.
++Estimate.
(a) Not including data for general government sector.
(b) Not including data for higher education sector.
(c) Persons with university degree or equivalent qualifications actually performing as technicians are included under the category "technicians".
(d) Not including data for productive enterprise sector.
(e) Technicians include "other personnel."
(f) Technicians are included with scientists and engineers.
(g) Not including data for social sciences.
(h) Data relate to general government sector only.

TABLE 4. AVERAGE RATES OF INCREASE IN NUMBERS OF PERSONNEL ENGAGED IN RESEARCH AND DEVELOPMENT*

Country	Period	Average Rate, %
Korea, Republic of	1965-69	26.2
Iraq	1966-69	24.8
Botswana	1967-68	18.8
Lebanon	1963-66	16.8
France	1963-67	9.5
U.S.S.R.	1960-65	9.4**
Cyprus	1965-69	5.5
Japan	1965-68	4.5
U.S.A.	1960-65	3.9**
Chad	1965-68	0.0
United Kingdom	1964-68	-0.2

*Computed from the UNESCO Statistical Yearbook, 1970.
**Computed from Reference 12.

TABLE 5. PERCENTAGE DISTRIBUTION OF RESEARCH AND DEVELOPMENT EXPENDITURES BY TYPE OF ACTIVITY*

Country	Year	Fundamental	Applied	Development
U.S.S.R.**	1966	20.0	80.0	
Czechoslovakia	1969	14.6	64.6	20.8
U.S.A.	1968	13.8	21.2	64.0
United Kingdom	1967	10.9	26.2	62.9
Japan	1968	30.0	21.[illegible]	[illegible]
Africa				
Chad	1969		82.2**	
Madagascar	1969	30.5**	69.5**	
Zambia	1967	17.[illegible]	38.3	16.[illegible]
Asia				
Ceylon	1968	17.6	15.1	5.5
Cyprus	1969		100.0	
Korea, Rep. of	1969	19.9	42.2	17.9
Lebanon	1967	27.0	33.0	[illegible]
Philippines	1964	27.1	72.9	
Thailand	1968	1.6	11.3	87.0

*From UNESCO Statistical Yearbook [illegible]
**Computed from Reference 13.

12. Kassem, M. S., "Soviet and American Policies on Science and Technology": Studies on the Soviet Union, New Series, Vol. 11, No. 3, 1971.

13. Zaleski, E., Science Policy in the U.S.S.R., Organisation for Economic Co-operation and Development, Paris, France, 1969.

tional and training institutions. It also reflects the growing volume of students from LDC's receiving their scientific training in the scientific institutions of advanced societies.

Fundamental Research, Applied Research, and Development

Comparative figures on the percentage distribution of research and development expenditures by type of activity in several countries are presented in Table 5.

As these figures indicate, the LDC's devoted a large share of their expenditures to applied research. However, some (Madagascar, Lebanon, Philippines) devoted a sizable proportion of their research and development expenditures to fundamental research.

Information about the 1970 distributions of manpower among government, industry, and academia is presented in Table 6.

These data indicate that, for most of the developing countries listed, the government employs the bulk of the manpower engaged in R&D. This may be attributed to the small scale of productive enterprise. This may be due also to the fact that in many of these countries, higher education is considered a part of government; also, research is, at best, only a part-time occupation in higher education in most of the LDC's.

Summary

Science and technology policies are new to most developing nations. However, the LDC's have an advantage in that they are in a position to develop coherent science policies. With limited resources and a social-economic structure tending to inhibit the easy adaptation of innovations, science and technology policies have even greater importance in the LDC's.

In the development of scientific and technological potential, the main determining factor other than investment is likely to be the lack of qualified personnel. Although considerable problems of definitions are involved, expenditures on R&D as a percentage of GNP are often used for international

TABLE 6. PERCENTAGE OF SCIENTISTS, ENGINEERS, AND TECHNICIANS ENGAGED IN RESEARCH AND DEVELOPMENT BY SECTOR OF PERFORMANCE*

Country	Year	Sector of Performance		
		Productive Enterprise	Higher Education	General Government
Czechoslovakia[a,b]	1967	86.0	3.8	10.2
U.S.A.[c]	1968	69.0	19.0	12.0
France[a]	1967	61.6	23.3	15.1
Germany, Fed. Rep. of[a]	1967	66.1	15.5	18.4
Japan[d]	1965	53.0	34.6	12.4
Cyprus[a]	1967	30.0	–	70.0
Philippines[e]	1964	18.0	12.7	69.3
Sudan	1965/66	22.6	16.8	60.6
Ivory Coast	1966	–	39.9	60.1
Rwanda	1967	–	19.0	81.0
Botswana	1966	–	–	100.0
Congo (Brazzaville)	1966	–	–	100.0
Ghana	1966	–	–	100.0
St. Helena & Deps.	1966	–	–	100.0
Somalia	1965	–	–	100.0
Upper Volta	1967	–	–	100.0
Bahrain	1967	–	–	100.0
Bhutan	1967	–	–	100.0

*Source: UNESCO Statistical Yearbook, 1970, pp. 474-475.
(a) In full-time equivalent.
(b) Including data for humanities.
(c) Source: NSF 70-16, Table 2, p. 8; general government sector includes data for nonprofit institutions and federally funded research and development centers.
(d) Relates to all fields of science and technology and human sciences.
(e) Not including data for social sciences.

comparisons of scientific efforts. Many of the LDC's included in this study are increasing their expenditures on R&D very rapidly. This indicates concentrated efforts on their part to reach and perhaps to exceed the targets set by UNESCO for the seventies.

Gross expenditure on R&D is of course not the only criterion of a nation's technological progress. The fields in which the R&D is carried out and relevance to economic growth, are also important. Distribution of R&D expenditures among fundamental research, applied research, and engineering development are other criteria.

This study points out that many of the LDC's put more resources into research than into development. In this respect, they seem to be following the Soviet pattern rather than the Western pattern, especially that of the United States. This may be due to the fact that in many of the LDC's, science in the narrow sense is relatively much more advanced than technology or engineering. In many of these countries, science growth centers are also more likely located in the Universities, where much emphasis is placed on fundamental research.

The relatively large proportion of expenditures on fundamental research in many of the LDC's may appear unnecessary, since

the results from fundamental research elsewhere may be universally available. However, fundamental research is not always without economic motivation just because the financial returns may be uncertain or in the far distant future. If properly oriented, fundamental research can be related to research lines relevant to developments in technology.

It is quite evident that many LDC's suffer from critical shortages of scientists and engineers as well as technicians. None of the developing countries included in this study reached the level that distinguishes between the scientifically advanced and the less advanced countries, with the exception of Chile. However, examination of the average rate of increase in personnel engaged in R&D reveals that some developing countries are increasing their stocks of scientists and engineers rapidly. The average rate of increase in some LDC's is six times as large as that in the United States. In some developing countries, education is to some extent in competition with R&D for the available human and financial resources.

Conclusions

Many LDC's have developed a national science policy which is reflected in their present efforts to accelerate their R&D activities. It is reasonable to assume that those countries that are currently engaged in expanding R&D efforts have already made some headway in increasing their scientific manpower. In the past two decades, many of the developing countries sent a considerable flow of students to the universities of the advanced countries. In addition, they proceeded to build their higher educational systems quite rapidly.

While many of the LDC's still lag behind the advanced countries in their present R&D capabilities, they are maximizing their efforts to close the gap. It is premature to attempt to forecast the future; nonetheless, if the present trends continue, the gap between developed countries and LDC'S which has widened since World War II may now be narrowing.

How fast the LDC's will be able to catch up depends largely on the attitudes and assistance of the advanced countries. These countries should devote a significant share of their R&D resources and facilities to projects specifically related to the problems of developing countries. They should encourage rather than discourage the scientific potential in the LDC's, through aid, manpower training, and scientific/cultural exchanges.

A final conclusion recognizes the painful process of cultural adaptation of science and technology in developing countries; however, there is nothing to suggest that the existing cultural barriers cannot be overcome. The LDC's seem to be willing to go through this painful process, as is evident in their efforts to build up their R&D capabilities.

Current Literature

AFRICA

2983. "Vast Potential in Resources", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.7.

Summarizes remarks of United Nation's officials at a meeting of the Committee on Natural Resources held in Nairobi; according to these officials: (1) Africa has a tremendous resources potential, with mineral resources discovered in Africa being estimated at US $25 billion; (2) energy supplies are such that Africa might think some day of exporting electricity; (3) petroleum is the most spectacular item in energy development on the Continent, with 7 countries each producing more than 5 million tons annually; (4) the prospects for minerals exploitation are greater than ever before; (5) a major need, however, is to bring adequate water supplies to rural and urban populations.

AGRICULTURAL SCIENCES

2984. Wilkes, H. G., and Wilkes, S., "The Green Revolution", *Environment*, v. 14, no. 8, October 1972, pp. 32-33, 35-36, 38-39.

Discusses the reasons for the recommendations of the U.N. Conference on the Human Environment concerning measures to preserve the rich inheritance of food crops now being displaced by new, high-yield crops (the Green Revolution); stresses that once the native-cultivated strains are dropped in favor of the introduced seed, the native varieties can become extinct in a single year, and it is within these "primitive" systems that the genetic wealth for future breeding lies; suggests two modes of preservation: on-site preservation, and the establishment of gene banks of collected material.

ASIA

2985. "Technology Transfer in Asia", *Industrial Research*, v. 14, no. 12, November 1972, p. 42.

Discusses 2 plans suggested by United Nations agencies directed toward helping underdeveloped Asia strengthen R&D ability and reduce the technology gap with more advanced nations: (1) establishment of an Asian Center for Technology Transfer & Investment by 9 Asian countries (Ceylon, Taiwan, India, Iran, South Korea, Thailand, the Philippines, Pakistan, and Malaysia), which would serve as a clearinghouse for collection and distribution of "the latest technological developments and break-throughs", and (2) adoption of an "Asian Action Plan" which sets 3 targets for 1980 to speed the Asian R&D efforts, calling (a) for expenditures by Asia of 1% of the GNP on R&D, (b) for developed countries to set aside 0.05% of their GNP to supply developing nations with scientific experts, technology, and equipment, and (c) for developed nations to earmark 5% of their nonmilitary research to help solve urgent problems of developing countries.

2986. Aswa-Ampywong, S. (Comp.), *AIT Publications and Student Theses*, A Preliminary Edition, Asian Institute of Technology, February 1972, 76 pp. (Available from AIT Library, P.O. Box 2754, Bangkok, Thailand.)

Comprises a computerized listing of AIT publications grouped according to type (i.e., reprints, research reports, technical notes, proceedings, etc.), as well as a listing of theses and dissertations; this list was compiled in response to the recognized need, particularly in developing countries, for institutions to make known their research results in order to effect technology transfer within countries as well as with other countries; detailed information is given on availability of the

various types of publications.

ATMOSPHERIC SCIENCES

2987. "Committee Weighs Research into Climatic Effects of Technology at High Altitude", *News Report (NAS, NRC, NAE)*, v. 22, no. 8, October 1972, p. 2.

Delineates the objective of a study by a National Research Council committee: to recommend research priorities for effects of technology in the stratosphere, for an extensive assessment program being undertaken by the U.S. Department of Transportation; outlines the issues to be studied, among which are: questions of atmospheric dynamics, physics, and chemistry; the nature of prospective emissions into the stratosphere; and biological effects, on earth, of stratospheric activities; included in the areas to be examined is the need for studies of the effects of aircraft nitrogen-oxides emissions on the earth's ozone layer.

2988. "Controlling the Controllers", *Nature*, v. 239, no. 5372, 13 October 1972, p. 364.

Presents the recommendations of the National Advisory Committee on Oceans and Atmosphere concerning weather modification: namely (1) that the U.S. expand its R&D program on weather modification and control; (2) that the U.S. end all military uses of weather modification, and conduct research, as far as possible, on an international basis; (3) that a lead agency be established to coordinate and regulate federally supported programs on weather modification, and that legislation be devised to define the rights and responsibilities of citizens, the states, and the Federal Government in this area; describes the state of the art of weather-modification technology, and defines the type of research needed, for example, basic research on cloud physics and R&D of the technology to mitigate hurricanes.

2989. "Weather Modification Reporting Rules Effective November 1", *U.S. Department of Commerce News*, Washington, D.C. 20230, NOAA 72-145, 9 November 1972, 2 pp.

Announces that the rules for reporting weather modification activities to the Commerce Department's National Oceanic and Atmospheric Administration have gone into effect, implementing P.L. 92-205 which requires all non-Federal weather modification activities in the U.S. and its territories to be reported to the Secretary of Commerce; records will be made public by NOAA to help avoid duplication of effort and territorial overlapping of operations.

2990. "ITOS-D Spacecraft Scheduled for Launch October 9", *U.S. Department of Commerce News*, Release NOAA 72-135, 8 October 1972, 6 pp.

Describes the National Oceanic and Atmospheric Administration's new environmental satellite, ITOS-D, which is designed to provide information on atmospheric and sea surface temperatures and on global weather systems, in order to improve weather forecasting services.

AUSTRALIA

2991. "Policy for Australia", *Nature*, v. 240, no. 5386, 10 November 1972, p. 63.

Notes the increasing amount of criticism being directed toward the Commonwealth Scientific and Industrial Research Organization (CSIRO), the chief channel for public expenditure on R&D in Australia; cites industrialists' major complaints, viz., that CSIRO is too detached from practical and commercial considerations; stresses the important part science policy questions will play in Australia's December elections, with the present Liberal government having already established the Advisory Committee, and the Labor party pledging if elected, to set up a Ministry for Science and Technology.

2992. Diamante, M. R., "A Résumé on Australia's CSIRO", *Philippine Science Review*, v. 13, no. 1, January-February 1972, pp. 50-58.

Describes the organizational structure of the Commonwealth Scientific and Industrial Research Organization (Australia's premier national research body), the nature of its scientific research, the dissemination of its research results, services, and publications, and its financing; recommends, among other things, that an Advisory Council be created to provide channels for advice and criticism of the

activities of the National Science Development Board, and that the NSDB establish a Regional Committee and Regional offices, laboratories, and field stations throughout the Philippines to do research related to the economic needs of the community.

AUSTRIA

2993. "Austria: Federal Report on Research for 1972", *Science Policy*, v. 1, no. 6, November/December 1972, pp. 1.7-1.8.

Presents highlights of the report, which reveals: (1) the total 1972 R&D expenditure by Government and industry (~S. 3,400 m, i.e., up 20.7% from 1971); the distribution of Federal expenditure on R&D (with the Federal Ministry of Science and Research receiving the major share, 79.5%); and (3) the allocation of Federal funds for research and research promotion (63.5% for research work in higher education centres and related establishments); outlines the objectives of Austrian R&D policy: for example, to increase R&D expenditure to bring it up to same level as that of comparable, industrial countries; to explore the possibilities of additional new methods of R&D financing; and to establish priorities for research, to strengthen its infrastructure, and to modernize its management; describes the functions of the Austrian Government's "Overall Research Concept", a medium- and longer-term master plan for promoting and financing research.

2994. "Austria: More Money Wanted for Industrial Research", *Science Policy*, v. 1, no. 5, September/October 1972, p. 1.4.

Reports the activities of the Industrial Research Promotion Fund, which has asked the Austrian Government for $40 million for next year; the Fund's Report for 1972 reveals that: total expenditure on industrial R&D in Austria rose from $1.3 million in 1969 to $1.7 million in 1971, increasing its share in the GNP from 0.41 to 0.43%; 253 projects were carried out in 1971, with chemical research being given top priority (24.5%), followed by engineering and iron and steel construction (~19%); $5.6 million was spent on environmental protection (5.3% of all research promotion funds); notes the trend toward increasingly complex and thus more expensive projects, which precludes a firm's bearing alone the risk involved in R&D; identifies industrial R&D priorities, the top three being (1) machinery, plant and apparatus, (2) electrical engineering, and (3) chemistry.

BIOLOGICAL SCIENCES

2995. *Biological, Medical, and Environmental Research Program*, Division of Biology and Medicine, U.S. Atomic Energy Commission Report, WASH-1211, 1972, 29 pp. (Available from Division of Biology and Medicine, USAEC, Washington, D.C. 20545.)

Outlines research programs for life scientists in the Biology and Medicine Division's overall program, which ranges in scope from the interaction of radiation with molecules of biological interest, to the movement of radioactivity in ecological, meteorological, and oceanographic systems, as well as the radiation biology of space exploration; the program involves expenditures of about $90 million per year, with the largest portion of the program being conducted in the AEC laboratories, and about 20% going to support individual studies in university laboratories and other nonprofit research institutions.

2996. "Boondoggle Criticism Hits International Bio Program", *Science & Government Report*, v. 2, no. 18, 15 December 1972, pp. 1-3.

Presents the pros and cons concerning the achievements of the IBP, which involves the use of large, multidisciplinary teams to analyze all components of a specific environment and the interactions that occur between them; IBP managers contend that the program can already be judged a success, and J. F. Reed, chairman of the U.S. National Committee for IBP, describes it as "a very strong beginning of . . . a new approach to science"; critics of the program charge that the IBP is serving as a haven for second-rank scientists, and that the actual work being done is, in some cases, mediocre; some of the IBP's leading proponents acknowledge that these allegations are essentially correct, but contend that such deficiencies do not invalidate the entire program.

BUDGET FOR R&D

2997. "R&D Funds Are Bottoming Out", *Chemical & Engineering News*, v. 50, no. 40, 2 October 1972, pp. 19-20.

Analyzes trends in U.S. Government financing of R&D, presenting statistics which reveal that total R&D funding in terms of constant dollars is today 9% less than it was at its peak in 1968; points out that while industry's R&D support has been more firm, it has not been strong enough to compensate for the falloff in Federal funds.

2998. "Congress Increases NSF Funds for 1973", *Physics Today*, v. 25, no. 10, October 1972, p. 63.

Announces the appropriation by Congress of $619 million plus $7 million in foreign currency for the National Science Foundation for FY 1973, which, together with the funds for education and institutional support now freed from impoundment, bring the total funding to $657.2, approximately $10.2 million more than the amount requested by the Administration; appropriations for individual programs, such as the Science Education Improvement Program, were also more than requested.

BULGARIA

2999. Brankov, G. (Ed.), *Bulgarian Academy of Sciences Reference Book, 1969*, Printing House of the Bulgarian Academy of Sciences, Geo Milev, 36th Street, Sofia, Bulgaria, 1969, 102 pp. (1.20 leva).

Briefly reviews the history and functions of the Academy, which was 100 years old in 1969; names the officers and members of the Presidium, and gives names, ages, fields, and addresses of the 45 academicians and 57 corresponding members, grouped according to department (Physics and Mathematics, Technical Sciences, Chemical Sciences, Geology and Geography, Biological Sciences, Medical Sciences, Philosophy, Economics and Law, History and Pedagogics, and Linguistics, Literature and Fine Arts); includes information about the departments, institutes, sections, laboratories, auxiliary bodies, and international organizational affiliations; presents an index of Academy publications and their staffs, as well as an alphabetical index of names.

CANADA

3000. "Robert J. Uffen: How Science Policy is Made in Canada", *Science Forum*, v. 5, no. 6, December 1972, pp. 3-8.

Cites a major recommendation of Canada's Senate Special Committee on Science Policy which calls for all government departments or agencies which can have a significant but indirect impact on the industrial innovative process while serving their main missions to acquire the services of science policy advisers, to delineate such impacts when administrative decisions are taken and new policies are formulated; notes the great interest displayed by members of the scientific community in serving in that capacity, describes the myriad problems a science adviser faces, and outlines the lengthy sequence of events that must precede the implementation of a new policy or program; includes statistics on federal expenditures on scientific activities, and comments on the latest trends.

3001. "Science and Technology Organization in Canada", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.1.

Presents highlights of a report *(Organization of Federal Science and Technology in Canada: Science Abroad)* by D. F. Downing, Scientific Counsellor, British High Commission, Ottawa; a priority task is to develop a global science and technology policy; the order-in-council setting up the Ministry of Science and Technology calls for Minister of State to assist departments and agencies of the Canadian Government in the formulation and development of advice with regard to: (1) the optimum investment in, and application of, science and technology in pursuit of national objectives; (2) the organization of the scientific establishment in the

public service of Canada; (3) the allocation of financial, personnel, and other resources to Canadian scientific endeavors; and (4) the extent and nature of Canada's participation in international scientific activities and the coordination of related domestic activities.

3002. "Canadian Science Ministry Passes First Birthday", *R&D Management Digest*, v. 2, no. 6, December 1972, p. 8.

Reports on the activities of the Ministry of State for Science and Technology, whose principal function is "to advise the government on all matters relating to science and technology, and in particular on the best means of harnessing activities in these areas to the achievement of national goals"; the Ministry also "coordinates scientific and technological programs with other federal programs and policies and seeks to promote cooperation with provincial governments, public and private agencies, and other countries in the field of science and technology"; under way are in-depth studies of methods for compiling statistical information about Canadian research programs, supply and demand for highly qualified manpower in Canada, and extension of science and technology information systems.

3003. Carruthers, J., "Controversy in the MOSST: What Should Its Image Be?", *Science Forum*, v. 5, no. 6, December 1972, pp. 16-17.

Considers the discussion taking place within Canada's Ministry of State for Science and Technology concerning the information role it should play; describes the approach favored by some within the ministry, i.e., discussion of policy alternatives before they are sent to the Cabinet for consideration, and the hearing of complaints and suggestions from other agencies (universities, industry, and scientific community, and the public in general) before and not just after decisions have been made; observes that this approach "seems to be the only proper way to transform the ad hoc decisions by government... into the studied, integrated policies and decisions that are urgently needed today in so many areas of science and technology".

3004. "Canada Emphasizes Contracting-Out", *R&D Management Digest*, v. 2, no. 4, October 1972, p. 11.

Reports that under a new policy of the Canadian Government, a progressively larger portion of government-funded R&D is to be done by industry, to help ensure that R&D results are translated more effectively into additional Canadian industrial capability; at the present time, slightly more than one-half of federally funded R&D is done in-house, and slightly less than one-quarter in industry; the Canadian Minister of State for Science and Technology believes that industry can strengthen the Canadian economy and create jobs through innovative R&D directed at the market place.

3005. Punchard, J.C.R., "Industry's Second Thoughts on the Contracting-Out Policy", *Science Forum*, v. 5, no. 6, December 1972, pp. 22-23.

Discusses the difficulties of transferring R&D from government in-house laboratories to industry, a move earlier urged by industry and recommended by the Senate Special Committee on Science Policy; e.g., (1) the difficulty of applying the criteria for research in government laboratories to industrial R&D; and (2) the lack of a stated level of funding to support R&D by industry; urges greater effort by the government in pursuing this new R&D policy, as a means of easing Canada's economic, unemployment, educational, and ownership problems.

3006. Litvak, I. A., and Maule, C. J., "Science Policy, Innovation, and the Small Firm", *Science Forum*, v. 5, no. 6, December 1972, pp. 9-11.

Briefly describes the findings of a 1971-72 survey of 39 technical entrepreneurs in small firms in the Canadian secondary manufacturing sector, conducted with the aim of suggesting directions for future government policies; examines the recommendations of the Senate Special Committee on Science Policy in the light of these findings, particularly the recommendations in areas which relate fairly directly to the small-firm study; e.g., (1) the establishment of a special committee on the future; (2) increasing industrial R&D; (3) cooperation between government and the academic and industrial sectors to consider their complementary roles in the national science, technology, and innovation effort; and (4) assistance with R&D activities in Canadian industry.

3007. Gibbons, M., "A New Study Tells Why Canadian Industry Lacks Innovative Drive", *Science Forum*, v. 5, no. 6, December 1972, pp. 26-29.

Reviews a report by P. L. Bourgault, former member of the Science Council of Canada, entitled "Innovation and the Structure of Canadian Industry"; outlines the objectives of the study, and summarizes (under the headings of investment, market, government and industrial import policy, and technology transfer) the principal disincentives to innovation in Canadian industry, as identified by the study; among the factors affecting technological innovation in Canada are the lack of the end-product capability needed to provide access to better and larger (domestic and foreign) markets, and the presence of foreign (particularly American) capital, technology, and management.

3008. "US First for Canada", *Nature*, v. 240, no. 5375, 3 November 1972, p. 7.

Discusses plans for launching Canada's Anik satellite (built in the U.S. by Hughes Aircraft) from Cape Kennedy on a U.S. Delta rocket, to be used solely for domestic telephone and television communications – the first such satellite to be used in the world; points out that, ironically, a comparable U.S. satellite won't be launched until at least 1974; describes the ground stations in Canada that will receive and transmit Anik's signals, and points out that a second satellite will be launched in about 6 months.

CHINA

3009. Tsu, R., "High Technology in China", *Scientific American*, v. 227, no. 6, December 1972, pp. 13-17.

Reports from a personal visit to China that there is high technology there, including specifically the computers, control systems, and instrumentation that make a modern industrial society function; reviews the scope of Chinese research in solid state electronics, computer systems, and semiconductor technology; concludes that "given China's present needs and its form of society, the country's industrial development may well be correctly 'balanced' ", notwithstanding its low per capita income and paucity of consumer goods.

3010. Lubkin, G. B., "Physics in China", *Physics Today*, v. 25, no. 12, December 1972, pp. 23-28.

Reports U.S. visitors' impressions that Chinese physicists are concentrating much more heavily on applied than on basic research, and that there is a society-wide attempt to make the higher-education system more democratic; describes the activities, personnel, and facilities at a dozen of China's advanced physics institutes and universities; summarizes observations of activities in astronomy, fluid mechanics, nuclear physics, and high-energy physics.

3011. Covault, C., "China to Launch Satcom 'in Near Future' ", *Aviation Week & Space Technology*, v. 97, no. 22, 27 November 1972, p. 14.

Reports an announcement by Dr. Tsien Wei-ch'ang, a member of a delegation from China visiting the U.S. as guests of the National Academy of Sciences, that China will launch a communications satellite in the near future; discusses the brief history of China's space research and future plans, and describes the activities of the delegation in the U.S.

3012. "More Cracks in the Ice", *Nature*, v. 240, no. 5375, 3 November 1972, p. 6.

Reports plans for a group of scientists from the Peoples' Republic of China to visit the U.S. at the end of November on the heels of a visit by a party of Chinese medical doctors; discusses the role of the Federation of American Scientists in laying the spadework for this visit then turning over the host duties to the National Academy of Sciences.

COMMUNICATIONS

3013. Klass, P. J., "Pentagon Expands Satcom Goals", *Aviation Week & Space Technology*, v. 97, no. 24, 11 December 1972, pp. 64-65, 67.

Describes the increasing role that communications satellites will play in achieving the Pentagon's recently stated telecommunications objectives of maximizing

reliability, survivability, security, and cost-effectiveness for both strategic and tactical missions; discusses the Defense Department's views and plans for military satcom systems, and the differences between their requirements and those of the civilian Intelsat (International Telecommunications Satellite Consortium).

3014. "TV by Satellite: UN Debates Curbs", *Science News*, v. 102, no. 22, 25 November 1972, pp. 341-342.

Discusses U.N. debates to curb the use of direct television broadcasts from satellites owing to concerns of many countries (especially if the satellite isn't their own) over such aspects as the possibility of interference with their sovereign affairs, the undermining of their national identity, and retardation of their cultural development; discusses U.S. opposition to such curbs, which stems from belief in the free exchange of information and ideas.

3015. "International Unit Hopes to Agree Within Year on Maritime Satellite", *Aviation Week & Space Technology*, v. 97, no. 22, 27 November 1972, p. 16.

Points out that the Intergovernmental Maritime Consultative Organization (IMCO) hopes to reach agreement on the plans and organizational arrangements for an international maritime satellite system for navigation and position-fixing within the next year, despite U.S. reservations that IMCO is moving too rapidly; describes a Soviet proposal before a recent 15-nation IMCO panel to set up the system called In-Mar-Sat, which the panel hopes to get approved during 1973 and created in 1974; agenda for next IMCO meeting includes discussions of plans for the first phase, gathering statistics and forecasting traffic, possible service sharing between aeronautical and maritime users, and the 1974 meeting.

COMPUTERS

3016. *Problems and Prospects of Fundamental Research in Multidisciplinary Fields — Computer Science*, Organisation for Economic Co-operation and Development, Science Policy Studies, 1972, 51 pp. (Available from OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. Price $1.75.)

Reports on an OECD survey having the aim of providing guidance to national science administrators and policy makers in Member countries in their efforts to stimulate oriented fundamental research, particularly in new multidisciplinary areas where the advancement of basic knowledge may be expected to help in solving major national or governmental problems; covers the scope and trends, the state of the art, and future needs for fundamental research in computer science; offers recommendation concerning education of specialists who will work in this field, the organization of the research, and the allocation of funds; emphasizes the need for large-scale government support of basic research in the computer sciences field, and urges a multinational program with adequate funds, particularly for education of specialists.

3017. "Support for Europe's Computer Science Field", *Inside R&D*, v. 1, no. 28, 11 October 1972, p. 3.

Presents findings of the Organisation for Economic Co-operation and Development concerning computer science in Europe; according to an OECD report, the status of the computer science field is not good, and OECD sees large-scale government support of such R&D as the only answer; the OECD report emphasizes the importance of this field for political, social, and industrial welfare, but finds that lack of R&D effort is hampering implementation, and plans are being drawn up by OECD to educate more computer scientists, put them to work on R&D, and direct government funds into this field.

CZECHOSLOVAKIA

3018. "Purge Sweeps Czech Science", *New Scientist*, v. 56, no. 814, 5 October 1972, p. 40.

Describes efforts of the Czechoslovak government to control its own Academy of Sciences by taking away the Academy's right to elect its own members and by dismissing already elected members; points out that some of the latter have been secretly reemployed in a lesser position, and suggests that the government may be

hoping that, by tighter control of the party apparatus and the administration of the universities and academic network, it will still be able to use its nonconforming scientists and technologists.

DEVELOPING COUNTRIES

3019. "U.N.: Application of Science and Technology to Development", *Science Policy*, v. 1, no. 5, September/October 1972, p. 3.7.

Describes the matters dealt with by the U.N. Advisory Committee during its 16th session in New York City, April 5-13, 1972; the Committee recommended adoption by the Economic and Social Council of the *World Plan of Action for the Application of Science and Technology to Development* [*SPR* 5(2):2190]; among the conclusions is that more research is needed on industrial technology based on raw materials produced by agriculture, on "post-harvest" technology, and on other appropriate industrial technology; outlines the Committee's work program plans for the next 3 years, which include: furthering the implementation of the World Plan of Action and devoting increasing attention to the question of appropriate technology, including transfer of technology from developed to developing countries.

3020. "Technology for Developing Nations", *R&D Management Digest*, v. 2, no. 5, November 1972, p. 7.

Reports on a survey made by R. Poats, an Agency of International Development official, while on research leave at the Brookings Institute; Poats assesses the opportunities and limitations surrounding technological attacks on key problems in the major sectors of agriculture, industry, health, nutrition, population, and education, and suggests research priorities and methods in the light of successful examples in both bilateral and multinational development programs; he also recommends more "joint research, experimental projects and training programs", and emphasizes the role of universities and nonprofit institutes as agents for providing technological aid.

3021. Farvar, M. T., and Milton, J. P. (Eds.), *The Careless Technology: Ecology and International Development*, Record of the Conference on the Ecological Aspects of International Development convened by the Conservation Foundation and the Centre for the Biology of Natural Systems, Washington University, December 1968, Airlie House, Warrenton, Virginia, The Natural History, Garden City, New York, 1972, 1030 pp. ($25.00)

Consists of fifty papers, the great majority being specific case studies, presented at a December 1968 conference on the ecological effects of development projects in underdeveloped countries, grouped under such headings as irrigation, health and nutrition, consequences of drives for increased productivity, and environmental degradation by other practices; includes verbatim discussions; papers generally reflect the unfortunate lack of coordination of development activities within a comprehensive ecologic framework.

3022. *Specialized Conference on The Application of Science and Technology to Latin American Development, Brasilia, Brazil, 12-19 May 1972*, Final Report, General Secretariat, Organization of American States, 1972, 178 pp. (Available from Organization of American States, 17th and Constitution Ave., N.W., Washington, D.C. 20006. Price: 50 cents.)

Reports on the Conference convened in response to a political decision to give impetus to a dynamic process intended to mobilize Latin America for the systematic application of science and technology to accelerate the region's development; broad topics covered include: (1) the creation and development of technology (including such subtopics as education and training of human resources in the area of science and technology and incentives to scientific and technological research and innovation); (2) technological innovation and transfer of technology; (3) cooperation for scientific and technological development; and (4) specific proposals for cooperation in science and technology among two or more Latin-American countries.

3023. "The Presidents' Program for the Educational, Scientific, and Technological Development of Latin America 1968-1971", *Américas*, v. 24, no. 4, April 1972, pp. S.1-S.48.

Presents the historical background of the inter-American cooperative program, the objectives and goals of the program, and the program strategy; summarizes the activities and achievements of the program over a 3-year period, in terms of the number of multinational projects undertaken, number of fellowships awarded, extent of collaboration of regional centers with international experts, financial support given, and the type and extent of supporting activities; presents statistical facts and figures which reveal the program benefits at the national level; highlights the most significant achievement, that is, the contribution that the Regional Educational and Scientific and Technological Development Programs have made to the process of Latin America integration.

3024. *Science Policy in Latin America* (In Spanish), Science Policy Studies and Documents, No. 29, Unesco, 1971, 233 pp. (Available from Unesco Publications Center, P.O. Box 333, New York, N.Y. 10016. Price: $3.50.)

Comprises the Proceedings (published in Spanish only) of the Third Conference on Science Policy in Latin America, which was held in Viña del Mar/Santiago, Chile, 6-13 July 1971; deals for the most part with the activities, organization, and resources involved in research and in technical education in 13 Latin American countries (Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Mexico, Paraguay, Peru, Uruguay, Venezuela, and Central America); includes recommendations adopted at the Conference concerning such topics as additional resources for Unesco activities in Latin America relating to science policy, international technical assistance for scientific and technical projects, and the project UNISIST (i.e., the establishment of a worldwide scientific information system).

3025. Spurgeon, D., "A New Approach to Foreign Aid: The IDRC of Canada", *Bulletin of The Atomic Scientists*, v. 28, no. 9, November 1972, pp. 33-36.

Describes Canada's new International Development Research Centre; its purpose, as set out in the Act creating it, is "to initiate, encourage, support, and conduct research into the problems of the developing regions of the world, and into the means for applying and adapting scientific, technical and other social advancement of these regions"; lists some of the 68 projects approved (with a $9,363,637 funding), such as rural development in Latin America, family planning in Mali, root crop production in Trinidad, technology in Thailand, and multilingual development information handling.

3026. Levin, N., "Israel and the Developing World", *Bulletin of the Atomic Scientists*, v. 28, no. 9, November 1972, pp. 37-43.

Points out that Israel, itself a developing nation, is providing others with technical aid that, while a small fraction of the $13 billion total worldwide investment in aid to developing countries, is having a great impact; cites examples of actions since 1958 by some of Israel's 4000 advisers toward development of 90 countries in Africa, Asia, Latin America, and the Mediterranean basin; notes that Israel's technical assistance program ($10 million annually) is coordinated by the Ministry of Foreign Affairs and that half the budget is spent in Africa; discusses financial, administrative, psychological, and political problems tied to mutual aid among developing nations and how Israel is circumventing these.

EARTHQUAKE RESEARCH

3027. Wade, N., "Earthquake Research: A Consequence of the Pluralistic System", *Science*, v. 178, no. 4056, 6 October 1972, pp. 39-43.

Presents conflicting views on duplication and overlapping research by the National Oceanic and Atmospheric Administration's Earthquake Mechanism Laboratory (EML) and the Geological Survey's National Center for Earthquake Research (NCER); according to the General Accounting Office, "the fragmentation of Federal responsibility and the lack of national goals have made it extremely difficult . . . to launch a coordinated attack on the nation's earthquake problem and to obtain maximum benefit from available resources"; the NOAA and the Survey insist that parallel research (not overlapping) is being conducted, and that this does not constitute wasteful duplication of effort; suggests that the

controversy may be resolved through definition of program goals in the statement of the fiscal 1973 budget and through the redefinition of the responsibilities of the various agencies involved in earthquake research expected to result from an Office of Management and Budget study.

3028. Wade, N., "Earthquake Accord and the Test Ban", *Science*, v. 178, no. 4056, 6 October 1972, p. 38.

Describes plans to place U.S. seismic devices on Soviet soil to further research on earthquake prediction, as part of the U.S.-Soviet agreement on environmental research; notes that the potential of these devices as a means of detecting underground nuclear explosions has aroused speculation regarding the significance of the agreement; presents views of prominent geophysicists who consider it unlikely that these devices will reveal information about Soviet nuclear tests not available by other means; points out that the U.S. has, however, proposed an exchange of seismic research information as a means of solving the on-site inspection issue which stalled negotiations on the Test Ban Treaty, and suggests that exchange of earthquake information could lead to discussion of methods of detecting underground nuclear explosions.

EAST GERMANY

3029. "Water Resources Policy for GDR", *Science Policy*, v. 1, no. 5, September/October 1972, p. 3.4.

Describes the water supply situation in the German Democratic Republic, which has the most overstrained water position of all industrialized countries, the average per capita water supply available amounting to only 850 cu m/yr, compared to a world average of 12,000; points out that with 80% of the total supply being used by industry, of which 40% is used as cooling water, thermal pollution of rivers and lakes is a serious problem; emphasizes that "the key to any sensible water resources policy is proper cleaning of the water after it has been used"; describes an experiment launched by the Ministry of Environment Control and Water Resources which was intended to encourage economy in water use as well as to control water pollution.

ECONOMICS AND SCIENCE

3030. *Research and Development and Economic Growth/Productivity*, Papers and Proceedings of a Colloquium, National Science Foundation Report NSF-72-303, 1972, 79 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: 75 cents.)

Section A presents 4 papers by economists who have written extensively in the field, all concerned essentially with the various aspects of relationship and contribution of research to economic growth, and all indicating, in general, that the contribution of R&D to economic growth is high, while acknowledging the need for further definition of this relationship; includes a bibliography; Section B reports on the discussions at the Colloquium which addressed 4 major questions (as did the papers), concerning what is known about the relationship between R&D and economic growth/productivity, how good is the state of the art on the subject, whether we are in a position to judge whether the U.S. is under- or overinvesting in R&D from an economic growth/production point of view, and what might be the logical steps in furthering such knowledge so as to reduce the area of judgment.

3031. *Gaps in Technology: Analytical Report*, Organisation for Economic Co-operation and Development, 1970, 300 pp. (Available from OECD Publications Center, Suite 1305, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. Price $8.00).

Provides data for the OECD countries in 4 key areas related to science, technology, and the economy: I. *Education* -- examines the educational and occupational characteristics of the labor force, current educational efforts, and the significance of the "brain drain"; II. *R&D* -- compares the level and structure of R&D efforts in the U.S. with those in industrialized OECD countries; examines

R&D in the science-based industries, the concentration and size structure of R&D in the Business Enterprise Sector, and basic research and the technological gap; III. *Technological Innovation* -- describes OECD countries' performance in the origination and diffusion of innovation, and the relation between diffusion of innovation and productivity increases; IV. *International Economic Exchanges* -- examines the influence of scientific and technological capabilities on international economic relationships in OECD countries.

3032. Johnson, J. D. (Ed.), *Survival and Growth: The Small R & D Firm*, Proceedings of the First National Conference Dealing with the Problems of the Small Firms in the Research and Development Industry, Washington, D.C., 12-14 June, 1972, NSF, SBA, and DOC, in cooperation with The American University, 1972, 300 pp. (Write Private Enterprise Center, SBA, Hamilton 209, The American University, Washington, D.C., regarding availability.)

Presents papers delivered at the Conference, and reviews discussions between representatives of government and industry concerning the problems of the small technical firm and the possibilities for growth; general presentations dealt with the problems of growth facing the small R & D firms, the present and future role of these firms, and their impact on science, technology, and the economy; panel presentations focused on such concerns as the problems of selling R & D to the Federal Government, meeting the research demands in non-Federal fields, strengthening the small R & D firms and new opportunities for them, and the small R & D firm in today's environment.

3033. Schott, F. H., "The New-Priority Problem", *Technology Review*, v. 75, no. 2, December 1972, pp. 39-43.

Contends that new accounting as well as new technology is needed to achieve the new social goals; discusses implementation of new national priorities and their implications for economic growth; examines the present GNP accounting system, "in which so-called growth is stimulated doubly: the more you pollute, the more you grow, and the more you then offset the adverse effects of pollution, the more you grow again"; describes an alternative system for aggregate economic output accounting proposed at the National Bureau of Economic Research which would consider gross and net output as independent variables for determining growth.

3034. Place, J.B.M., "Wanted: A Changed Environment for the Mining Industry", *Congressional Record*, v. 118, no. 165, 13 October 1972, pp. S17863-17864.

Discusses 7 problem areas facing the U.S. mining industry: scarcity of new ore bodies and declining ore grades; environmental protection; labor; politics; capital requirements; economic, fiscal and monetary policies; and world trade and tariffs; describes the efforts of the mining industry to solve these problems, warns of overreaction to alarmism by environmentalists, and offers suggestions concerning needed Government actions (e.g., tax incentives and depletion allowances) and needed policy changes.

EDUCATION

3035. Doty, R., and Zinberg, D., "Undergraduate Science Education: An Overview", *American Scientist*, v. 60, no. 6, November-December 1972, pp. 686-695.

Assesses the overall experience of science majors in the U.S., and considers the character of the environment in which they are likely to work as well as the supply and demand picture for science graduates or their career prospects; offers suggestions for the improvement of science education, concerned with the structure and content, and with the experience of research and the need for courses that relate science to technology, the environment, and public policy.

3036. Millard, R., Sweeney, K., and Eklund, N., *Planning and Management Practices in Higher Education: Promise or Dilemma?* Proceedings of the National Forum on New Planning and Management Practices in Higher Education, Denver, Colo., 26-28 January 1972, 218 pp. (Available from Education Commission of the States, 300 Lincoln Tower, 1860 Union St., Denver, Colo. 80203. Price: $3.50.)

Presents the talks delivered at the National Forum which opened with an address on the problems of higher education leadership in the 1970's, and continued with

the presentation of overviews and cautions regarding goal setting and evaluation, planning and resource allocation, and execution and operation; other addresses deal with the implications of existing planning and management systems, strategies to meet the inevitable demand for cost studies and other analytical reports in relationship with resource allocations, the trends and developments in higher education, and the external pressures – by State and Federal governments and the public – that call for improved planning and management practices; includes an appendix containing abstracts of systems' descriptions presented at the Forum.

3037. "Broadening the PhD", *Nature*, v. 239, no. 5371, 6 October 1972, p. 299.

Discusses an informal report, *Broader Education for Graduates*, by a joint committee of the Science Research Council and the Social Science Research Council which identifies opportunities for developing more broadly based PhD courses that would be "intellectually as demanding as the traditional PhD . . . but more directly oriented towards industrial careers"; according to the Committee, this type of PhD course is essential for meeting the need "to use the enormous resources derived from the discoveries of science and the developments of technology in ways that give the maximum benefit and the minimum harm to the community".

3038. Blandford, B. A., and Trexler, J. C., *Expected First-Year Graduate Enrollment in Science and Engineering, Fall 1972*, Report of the Higher Education Panel, American Council on Education, Survey No. 10, 11 August 1972, 24 pp. (Available from the Higher Education Panel, ACE, 1 Dupont Circle, Washington, D.C. 20036.)

Presents results of a survey of 91 institutions granting doctoral degrees in science or engineering; according to the survey, an overall increase of 2% in first-year science and engineering graduate enrollments is expected this fall, but the projected trends differ according to type of institution and field; the "top twenty" institutions (so designated on the basis of their selection by NSF fellows and of Federal R&D funds awarded) expect declines in enrollments in all major science and engineering fields; "developing" institutions (those which first awarded doctorates in these fields in 1960 or later) expect enrollments to drop in physical sciences, social sciences, and engineering and to rise in other major categories; other institutions expect increases in all major categories except engineering.

3039. Lipsitz, L. (Ed.), *Technology and Education*, Educational Technology Publications, Inc., Englewood Cliffs, New Jersey, 1971, 179 pp. ($5.95)

Presents a compilation of 18 articles dealing with the various elements comprising the area of educational engineering technology, ranging from definitions of educational technology to instructional media, systems, mass media, the computer, and programmed instruction; also treated are the politics of educational objectives (how they are set and why, with suggestions as to how they might better be set), and the impacts of technology on education.

3040. Reidel, C. H., "The University: An Environmental Perspective", *Vital Speeches of the Day*, v. 39, no. 2, 1 November 1972, pp. 45-47.

Considers the reasons for the universities' general lack of response to the need for environmental programs, suggesting that the reasons stem from the environmentalists' "seemingly paradoxical demand for 'action' while insisting that mankind is already hopelessly doomed"; calls for a recommitment of universities to involvement with current problems and the needs of society, and assesses the effects of such involvement on academic life styles; outlines changes in the universities which will be necessary to deal with future problems, e.g., environmental degradation, among which are: the removal of artificial barriers between disciplines, departments, and colleges, the rebuilding of broken ties between teaching, research, and services, and new methods of budgeting and administration that create interdepartmental cooperation.

3041. Hagg, F. G., and Ketchum, G. M., *How, When and Where Does the Engineer Learn About Values?* Preprint of paper (No. 72-WA/TS-5) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 5 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Discusses the inadequacy of the traditional method of requiring a distribution of courses in nonengineering subjects (e.g., liberal arts or the humanities and social

sciences) as a means of injecting value considerations into the engineering curriculum; describes several alternative approaches, among which are interdisciplinary project courses, "disputed questions" courses, and a general infusion of the awareness of values into the infrastructure of the engineering courses themselves; stresses the responsibility of the engineer for the consequences of his work, particularly those affecting public health and safety and the environment.

3042. Torda, T. P., *An Interim Progress Report on the Education and Experience in Engineering (E^3) Program*, Preprint of paper (No. 72-WA/TS-3) presented at the Winter Annual Meeting of The American Society of Engineers, New York, N.Y., 26-30 November 1972, 5 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Presents the reasons for the development of the E^3 program (supported by the National Science Foundation) which offers a radical departure from conventional and undergraduate curricula and methodology available in engineering colleges; describes the focus of the first year of the 5-year program, viz., the development of many of the proposed concepts which are included in the program; discusses some of the results achieved during the planning year and some of the experiences during the first few months of implementation.

3043. Bruner, K., Weeks, K., and Kern, P. (Comps.), *International Education Resources: A Summary of OE-Funded Research Projects and Reports Available Through the Education Research Information Center, 1956-71*, U.S. Department of Health, Education, and Welfare, Office of Education, 1972, 370 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: $3.50.)

Provides a comprehensive listing of projects with international aspects or dimensions funded by the U.S. Office of Education, which includes the following categories of international education: foreign area studies, education systems, education in social and economic development, foreign students, and bibliographies and directories of international education resources; Part I contains 450 annotated references; entries in Part II, arranged according to (1) countries or territories and (2) regions, gives bibliographic information only, cross-referenced by geographic area.

ENERGY CONSERVATION

3044. Hammond, A. L., "Conservation of Energy: The Potential for More Efficient Use", *Science*, v. 178, no. 4065, 8 December 1972, pp. 1079-1081.

Stresses the need for conserving energy, and identifies the major end uses: (1) transportation and (2) space heating in residences and commercial buildings; suggests measures to reduce energy consumption in these two areas: e.g., improved structural design, better insulation, improved design of space heating units, the use of more efficient furnaces by industry, and a shift to rail transport (both passenger and freight) and urban mass transit; points out that the potential for conserving energy through more efficient use appears to be enormous, but that financial incentives and other means of changing attitudes and habits in energy use will be necessary to realize this potential.

3045. *The Potential for Energy Conservation; A Staff Study*, Executive Office of the President, Office of Emergency Preparedness, October, 1972, 236 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: $2.00.)

Presents projections of energy demand for the next 15-20 years, and the sources of supply to meet that demand; suggests that conservation measures can reduce U.S. energy demand by 1980 by as much as 7.3 million b/d of oil (equal to about 2/3 of the projected oil imports for that year); identifies the most significant realizable measures to effect conservation: (1) improved insulation in homes; (2) adoption of more efficient air conditioning systems; (3) shift of intercity freight from highway to rail, intercity passengers from air to ground travel, urban passengers from automobiles to mass transit, and consolidation in urban freight movement; and (4) introduction of more efficient industrial processes and equipment.

3046. Paschkis, V., *Cutting Back Energy Consumption . . . Why? How?* Preprint of paper (No.

72-WA/TS-7) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 9 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Discusses the energy crisis, and the factors which dictate a reduction in energy consumption (dwindling fuel resources, pollution, and the finite nature of the earth's heat sinks); describes the inequalities in energy consumption (both internationally and nationally): e.g. (1) the U.S. has by far the highest per capita consumption, and (2) the population with the highest income has a far higher share of energy consumption, in the household, in industry, and in transportation; discusses the areas where energy savings are possible, and examines the ways in which such savings can be achieved.

3047. Hammond, A. L., "Energy Needs: Projected Demands and How to Reduce Them", *Science*, v. 178, no. 4066, 15 December 1972, pp. 1186-1188.

Discusses projections of vast increases in energy demand, noting that they are, in general, based on previous trends in overall economic and population growth, and are likely to be accurate only if past trends continue essentially unchanged; describes studies of the demand for electricity, under a variety of alternative assumptions, which indicate that rising prices, as well as population decreases, may reduce the demand for power; discusses various proposed measures for promoting energy conservation among which are: higher prices, tax incentives and subsidies (or their removal), changes in building codes to require more insulation in houses and heat-reflecting glass in office buildings, and restriction of advertising that encourages energy use.

ENERGY – CRISIS

3048. Chapman, D., Tyrell, T., and Mount, T., "Electricity Demand Growth and the Energy Crisis", *Science*, v. 178, no. 4062, 17 November 1972, pp. 703-708.

Presents an analysis of electricity demand growth predictions made by government, industry, and university researchers, which suggests that the demand growth has been overestimated; outlines the factors influencing the demand for electricity (population, income, energy prices, and total energy demand), noting that these factors are themselves apparently departing from long-established patterns; presents electricity demand projections derived on the basis of differing assumptions as to population, income, and prices; suggests research to clarify the nature of substitution between energy forms, as well as the growth of each energy form and of total energy use.

3049. Boyer, V. S., Bertolet, A. D., and Fitzpatrick, R. J., *Industry's View of the Future Supply and Demand of Electric Energy*, Preprint of paper (No. 72-WA/TS-8) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 8 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Stresses the importance of an abundant supply of electric energy to the well-being of society, and discusses the growing demand for electric power in the residential, commercial, and industrial sectors; describes the delays facing the electric utility industry due to protracted regulatory reviewing processes and environmental opposition, and calls for support from regulatory agencies and society in general to aid the industry in meeting its commitments; explains the industry's commitment to research, claiming that through increasing R&D, the industry will be able to supply growing demands in an environmentally acceptable manner.

3050. Freedman, S. I., *Technical Alternatives for Energy Management*, Preprint of paper (No. 72-WA/Ener-6) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y. 26-30 November 1972, 11 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Summarizes the energy sources available and the limiting aspects of each; describes the current energy situation, emphasizing the need for more technology which can

provide the means to supply sufficient energy at economic and environmentally acceptable costs; identifies the 4 basic options in the energy and power generation field (more efficient generation, use of new energy sources, more efficient energy use, and controlled energy use); discusses means of exercising these options, e.g., through the use of more efficient energy conversion technologies and the development of processes to use new energy sources (nuclear, fusion, gasified coal, geothermal, and solar).

3051. Cook, E., "Energy for Millenium Three", *Technology Review*, v. 75, no. 2, December 1972, pp. 16-23.

Examines the past and future of man's uses of energy resources, describing how constraints such as capital investments and the ecology will determine future energy sources; claims that society must replace its "mined-energy economy", and while it continues to seek adequate replacement systems through scientific and technological efforts, it needs to consider reducing both its appetite for energy and its numbers; contends that "man must ultimately return to renewable sources of energy" which would be solar radiation or nuclear fusion, both of which face severe constraints.

3052. Dinneen, G. U., and Cook, L., *Oil Shale and the Energy Crisis*, Preprint of paper (No. 72-WA/Fu-3) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 9 pp. (Available from ASME, United Engineering Center, 345 East 47th Street, New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Describes the extent of this resource, current and developing technology for producing and utilizing shale oil, and the economics and potential of shale oil as an energy source; describes a planning program being implemented by the Department of Interior to lease for development a limited number of publicly held oil share tracts.

ENERGY – ENVIRONMENT

3053. Schurr, S. H. (Ed.), *Energy, Economic Growth, and the Environment*, The Johns Hopkins University Press, Baltimore and London, 1972. ($10.00)

Contains papers presented at a Forum conducted by Resources for the Future, Inc., in Washington, D.C., 20-21 April 1971, grouped under 3 broad topics: (1) economic growth, (2) energy growth and the environment, and (3) problems of public policy; the papers deal specifically with the reconciliation of growth and environment, the environmental cost of economic growth, the effects of environmental restrictions on energy costs and availability, and reconciliation of energy and environmental goals; includes an appendix which examines the trends and patterns of energy consumption; indexed.

3054. Barus, C., *On the Limits to Energy Release and Implications for Present Policy*, Preprint of paper (No. 72-WA/TS-1) presented at Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 8 pp. (Available from ASME, United Engineering Center, 345 East 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Examines the possible consequences of the release of vast amounts of waste heat from power plants (e.g., serious climate modification, increase in global temperature, and melting of the polar ice cap), and discusses the limits to energy release set by the finite capacity of heat sinks such as the atmosphere, the oceans, and the landscape); emphasizes the responsibility of engineers to plan for such limitations, nd considers possible modes of approach to a limit in the light of current trends, published predictions, and the problem of meeting human needs; suggests that a new departure in the design of the world's energy production-distribution-allocation system is urgent to avert a new kind of energy-humanity crisis, and that U.S. planning for an orderly and equitable transition to a fixed-energy-rate economy is already overdue.

3055. Hillman, R. E., "Effect of Power Plants on Coastal Ecology", *Littoral Lines* (Battelle), No. 1, September 1972, pp. 1-2.

Describes the growing concern over the future of coastal zone areas, aroused by

the increased building of both steam-powered and nuclear generating plants in these areas; discusses ecological impacts of hot water discharges, construction activities, the use of biocides in the water-intake structures, entrainment of planktonic organisms in the intake water, and the minute releases of radioactivity from nuclear power plants.

3056. "Plains Energy Complex: Debate Quickens", *Science News*, v. 102, no. 16, 14 October 1972, pp. 244-245.

Discusses arguments offered by the environmentalists and the energy companies concerning the construction and development of a coal reserve in Montana and Wyoming, which has the potential of becoming the largest single natural resources project in the world; environmentalists are mainly concerned with the unanswered questions of reclamation, and with water use should the utilities opt for coal gasification plants at the mine mouth, which would use far more water than would power plants -- in an area that is semiarid and water short; while the utilities point to the energy crises, to the jobs a coal processing complex would provide, and to an improved economy for the area in general.

3057. "Converting Fuel Oil Into Low-Sulfur Gas", *Industrial Research*, v. 14, no. 12, November 1972, p. 37.

Describes the potential of a fluidized-bed fuel-oil conversion process being studied by Esso Petroleum Co. under an Environmental Protection Agency contract; according to the EPA, the process shows promise for reducing sulfur oxide emission from large power stations burning high-sulfur fuel oils, and is expected to have a cost advantage over other sulfur-removal methods; the total development program is aimed toward conversion of a 100-Mw power station in the U.S., which, if successful, will open the way to widespread adoption of the process.

3058. "Environmental Review", *Nature*, v. 240, no. 5380, 8 December 1972, p. 318.

Discusses the question facing the Atomic Energy Commission, of whether the environmental review of individual nuclear power stations should include the environmental effects associated with producing and fabricating the uranium fuel, reprocessing the spent fuel rods, and getting rid of the radioactive wastes; describes a survey published by the AEC of the environmental costs associated with the fuel cycle for a model light-water-cooled reactor plant producing 1,000 MWe.

3059. *Nuclear Power and the Environment*, prepared by the International Atomic Energy Agency in cooperation with the World Health Organization, 1972, 85 pp. (Available from International Atomic Energy Agency, Kärntner Ring 11, P.O. Box 590, A-1011 Vienna, Austria.)

Describes world energy resources, future world energy needs and the role of atomic energy in meeting these needs; deals with radiation protection standards, the safe handling of radioactive materials (including wastes), and nonnuclear impacts on the environment, such as those arising from plant construction and thermal discharges; outlines the effects of the use of atomic energy on the environment, as compared with fossil fuel; concludes that it is necessary that the nuclear industry exercise careful control to minimize any possible risks -- while maximizing benefits to the public -- and keep the public informed about them.

3060. Schlesinger, J. R., "Power Production, Health and the Environment", *AEC News Releases*, v. 3, no. 46, 15 November 1972, pp. 10-14.

Discusses the problems facing further development of nuclear fission as the primary source of energy for the future, and relates the nuclear generating facilities and the alternatives to the broader national energy picture; assesses the overall health and environmental impacts of energy usage, particularly the effects of nuclear energy use.

ENERGY -- FUEL SUPPLY

3061. Theobald, P. K., Schweinfurth, S. P., and Duncan, D. C., *Energy Resources in the United States*, U.S. Geological Survey Circular 650, 1972, 27 pp. (Available from U.S. Geological Survey, Washington, D.C. 20242.)

Presents estimates of U.S. resources of coal, petroleum liquids, natural gas, uranium, geothermal energy, and oil from shale, generally based on geologic

projections of favorable rocks and on anticipated frequency of the energy resource in these rocks; total resource base estimates are: coal, ~3,200 billion tons; petroleum liquids, ~2,900 billion barrels; natural gas, ~6,600 trillion cubic feet; uranium resources in conventional deposits are estimated at 1.6 billion tons of U_3O_8; information on the resources of heat in potential geothermal energy sources are insufficient, but the total resource base is believed to be greater than 10^{22} calories; oil shale is estimated to contain 26 trillion barrels of oil, but none of this resource is economic as yet.

3062. "Energy Study Most Comprehensive Yet", *Chemical & Engineering News*, v. 50, no. 51, 18 December 1972, pp. 4-5.

Discusses the National Petroleum Council's completed study the "U.S. Energy Outlook", which (1) analyzes effects of changed economics and Government policies on the energy situation, (2) develops a range of demand and supply projections through 1985, (3) assesses financial requirements and balance of trade effects, (4) surveys broad trends beyond 1985 to 2000, and (5) recommends policies to improve the U.S.'s energy posture; the NPC sees only 3 options open to the U.S.: (1) restraint on energy demand and growth, (2) much greater reliance on energy imports from foreign sources, or (3) increased emphasis on development of domestic energy sources; NPC estimates that U.S. indigenous fuel resources *could* satisfy demand for energy to 2000 if they were called upon to do so.

3063. Yaffee, M. L., "DOD, Airlines Face Energy Crisis", *Aviation Week & Space Technology*, v. 97, no. 21, 20 November 1972, pp. 54-57.

Discusses the growing fuel shortage facing the Defense Department and U.S. airlines, pointing out that there are no short-term solutions other than paying higher prices or importing more, and that if the situation continues, by 1985 the U.S. will have to import over 50% of its overall required petroleum fuel; lists the amounts of various fuels consumed by transportation, and outlines recommendations of the Transportation Department's interagency transportation-energy panel, among which are: (1) work should be continued on improving propulsion efficiencies through further R&D on such things as staged combustion, controlled-temperature-rise combustion, and premixed combustion systems; and (2) additional work should be initiated on "new" combustion systems (such as nuclear combustion).

3064. "New Oil From Old Fields", *Technology Review*, v. 75, no. 1, October/November 1972, pp. 58-59.

Points out that despite the failure to discover new oil resources, U.S. oil added per unit of exploration investment has been relatively stable, while gas reserves have dropped and development costs per added unit have soared; explains the reasons for this: primary production realizes only 1/5 to 1/3 of total oil potential in any given field; the petroleum industry is thus able to capitalize on innovative "secondary recovery" processes through which considerable increments of oil can be recovered from known fields; secondary recovery is fruitless for the gas industry, since a large proportion of gas is recovered in the primary phase; no prediction is made as to how long these domestic oil reserves will last, but it is suggested that "the domestic oil industry should not be counted out too quickly".

3065. "The Oil Companies, the Energy Gap — and the Deep Thinkers", *Congressional Record*, v. 118, no. 5, 5 October 1972, pp. S17077-17078 (Reprinted from David L. Babson & Co. weekly letter, 28 September 1972).

Comments on the role of petroleum in the U.S. energy scheme, pointing out that 75% of U.S. energy requirements are derived from oil and gas, and stressing the urgent need for the U.S. to markedly increase not only its capacity for crude oil and gas production, but also its refining and transportation capabilities.

3066. "Future of Coal", *Nature*, v. 240, no. 5383, 29 December 1972, p. 516.

Describes a report by the British coal industry which argues that coal is an indispensable part of any future European energy plan, and suggests that an energy policy for the enlarged Common Market should be based on 3 points: (1) that oil from the North Sea should be used to displace imported oil rather than other indigenous energy sources; (2) that natural gas should be conserved by restricting its use for premium purposes; and (3) that nuclear power should be developed at

the most economic rate, keeping its long-term potential in mind.

ENERGY – NATIONAL POLICY

3067. McLean, J. G., "The United States Energy Outlook: Its Implications for National Policy", *Vital Speeches of the Day*, v. 39, no. 3, 15 November 1972, pp. 72-75.

Summarizes the energy situation, emphasizing that while the U.S. long-term energy position is reasonably sound, serious energy problems may be experienced in the medium term (through about 1985); outlines the major problems that must be faced, such as those associated with the need to import large volumes of foreign oil and gas to meet U.S. energy requirements, launching the effort necessary to expand U.S. nuclear power and coal outputs, and the need to generate the huge capital investments required to increase energy supplies; discusses the economic and foreign policy implications of U.S. dependence on foreign sources of oil and gas, and outlines actions which must be taken, foremost of which is the development of a comprehensive national energy policy.

3068. "Towards a National Energy Policy", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.6.

Presents details of a 12-month, $2 million Energy Policy Project, established by the Ford Foundation, New York, to be headed by S. David Freeman, former head of the Energy Policy Staff in the Executive Office of the President, with Professor Gilbert White, Director of the Institute of Behavioral Sciences, University of Colorado, serving as Chairman of the Board of Advisors; the project will explore the policy aspects of the possibilities of more efficient energy use, the role of energy in everyday life, the structure of the energy industries, the environmental impact of energy use, land-use planning, the management of Federal energy resources, and tax policies.

3069. "U.S. Energy Policy Project: Study Plan", *Science Policy*, v. 1, no. 6, November/December 1972, p. 1.6.

Identifies the 5 major areas of study to receive priority under the Energy Policy Project: (1) the quality of life, (2) energy and life styles, (3) efficiency and conservation, (4) international outlook, and (5) scenarios of the future; respectively, these studies are intended to: (1) cover social benefits/costs of energy use, environmental problems, and policy issues, and the energy use/standard of living relationship; (2) develop new data on how individuals use energy, to show the future effects of energy policy (or lack of it); (3) provide policy makers with a better understanding of the opportunities for greater efficiencies of energy use in the industrial sector; (4) provide an analysis of the security of energy supply, economic and foreign policy issues; (5) consider future worldwide energy demand and examine U.S. relations with producing nations, developed consuming nations (e.g., Western Europe and Japan), and the less developed nations.

3070. *United States Energy: A Summary Review*, U.S. Department of the Interior, January 1972, 72 pp. (Available from U.S. Department of Interior, Washington, D.C. 20240.)

Emphasizes the need for a national energy policy, and for specific guidelines for formulating this policy; reviews national objectives such as environmental quality, consumer protection, conservation, national security, and international trade which are increasingly being considered in the provision of adequate energy supplies; presents a base forecast of energy demand in the year 2000 (by major sources and uses) modified to show the effects of a high and a low range of nuclear energy development, and a forecast of demand for energy resources in the near term (1975), intermediate term (1985), and long term (2000); summarizes the results of detailed studies on energy resource and supply problems for the individual fuels (electric power, coal, gas, petroleum) as well as other energy sources (solar, fusion, tidal, fuel cells).

3071. "Energy Supply Planning Crucial", *Industrial Research*, v. 14, no. 13, December 1972, p. 31.

Presents the opinions of C. Starr, Dean of Engineering & Applied Science, University of California at Los Angeles, regarding the energy crisis; Starr emphasizes that the important requirement now is to develop policies for future energy needs,

and that considerable data are needed to answer such questions as whose resources will be used, where power will be generated, who shall receive the pollution from such activities, and what is the relationship between energy use, quality of life, and public health dangers; Starr indicates that although his studies show sufficient fossil fuels available for near-term demands, future demands will call for nuclear or other forms of energy, and asserts that "given the right decisions, the impending energy crisis . . . can be avoided.

3072. "Energy: New Policy Seen", *Washington Science Trends*, v. 29, no. 2, 20 November 1972, p. 29.

Commerce Secretary P. G. Peterson announces that in early 1973, the Nixon Administration will propose a new energy policy, and a "comprehensive" approach to the energy problem; Peterson stresses the "crucial" role of R&D in finding new and balanced answers to reconcile environmental, safety, and energy needs; he also expresses the hope that the U.S. will not concentrate on "more exotic forms of new energy", noting that the U.S. has large coal reserves, and that many proposed research programs relating to this fuel supply "are manageable, not excessively expensive, and within the state-of-the-art".

3073. "Government R&D Plans in Energy Field", *Inside R&D*, v. 1, no. 37, 13 December 1972, pp. 2-3.

Discusses the U.S. Government's new energy program, details of which will be spelled out by President Nixon early in 1973; according to reports, the emphasis will be on coal liquefaction, solar energy, geothermal sources, and new excavatin techniques for coal and gas, and indications are that the Office of Management and Budget agrees, but is slashing dollar amounts (e.g., $56 million for nuclear fusion R&D in FY 1974 cut to $41 million); expected to spark debate are recommendations for gaining access to energy raw materials, among which are the use of nuclear explosives to loosen gas locked in the Rocky Mountains and offshore leasing for oil exploration in the Atlantic continental shelf.

3074. Sporn, P., *The Social Organization of Electric Power Supply in Modern Societies*, The M.I.T. Press, Cambridge, Mass., 1971, 145 pp. ($6.95)

Compares the histories and evaluates the technical performance of public and private power in the U.S. and in other countries; discusses their responses to emergencies, and other aspects of public interest; presents some of the problems which lie ahead in the electrical supply industry and comments on the relative abilities of private and public power companies to cope with them; makes several points in favor of continuing the present pattern of predominantly investor-owned electrical power utilities in the U.S.; observes that politics and technology do not mix well.

3075. Lippert, T. W., "As to Technical Priority, the Administration has Assigned Top Spot to the Liquid-Metal Fast Breeder Reactor", *Research/Development*, v. 23, no. 11, November 1972, p. 18.

Presents the pros and cons of the LMFBR expressed by the AEC and environmentalists during hearings held by the Joint Committee on Atomic Energy to check on any possible hangups in the breeder reactor program; describes the probable cost of the Oak Ridge demonstration project to develop a breeder of manufacturing capability, and the funds expected to be contributed by the Government, the utilities, and the successful bidder for the contract (G.E., Westinghouse, or North American Rockwell); notes the Committee's insistence that the lead reactor manufacturer promise to heavily subcontract to the other two — feeling that all three will be needed to build the scores of LMFBR's that must be on the utility networks in the early 1990's.

ENERGY – NUCLEAR

3076. Hammond, A. L., "Fission: The Pro's and Con's of Nuclear Power", *Science*, v. 178, no. 4057, 13 October 1972, pp. 147-149.

Discusses the overall characteristics of nuclear fission as a source of energy, together with its potential advantages and disadvantages; notes the growing concern in the scientific community about concentration on nuclear power and the

consequences of its large-scale use; outlines the chief concerns: operating hazards (particularly the chances of a serious reactor accident), the difficulties of safeguarding the fissionable materials used as fuels, the problem of long-term storage of radioactive wastes, and the vulnerability of nuclear power systems to technological failures, to natural disasters such as earthquakes, and to human actions such as carelessness and sabotage; delineates the advantages of nuclear fission over traditional sources of energy: (1) reduced air pollution; (2) reduction of mining, and of the associated water pollution land disruption, and human injuries; and (3) lowered transportation costs.

3077. "Remarks by D. L. Ray at the Conference on Water Quality Considerations, Atomic Industrial Forum, Washington, D.C., 3 October 1972", *AEC News Releases*, v. 3, no. 41, 2 October 1972, pp. 5-6.

Mr. Ray, a new member of the U.S. Atomic Energy Commission, outlines his personal plans and ambitions for the AEC, placing high priority on achieving public understanding of nuclear energy; describes concerns over the environmental impacts of nuclear power plants, in particular, the effects of thermal discharges and danger of radiation exposure, and the need for further research to determine the extent of such impacts and the best technical approach toward mitigating them.

3078. Doub, W. O., "The International Nuclear Market", Remarks before the Executives' Club of Chicago, *AEC News Releases*, v. 3, no. 48, 29 November 1972, pp. 7-11.

Mr. Doub, Commissioner, U.S. Atomic Energy Commission, reviews international developments which are bringing about a radically changing world energy market for the U.S.; discusses the expanding international nuclear market and the capability of the U.S. to deal with increasing nuclear industry competition from abroad; notes the U.S. monopoly on uranium enrichment techniques, but points out that 5 nations are potential competitors based on the emerging gas centrifuge technology; predicts a bright future for the U.S. liquid-metal-cooled fast breeder reactor in world trade.

3079. "Atomic Industrial Forum Study of Nuclear Power Programs", *Manpower Comments*, v. 9, no. 10, November 1972, p. 4.

Presents the recommendations of the Forum, an industrial organization of the nuclear power industry, which resulted from the Forum's year-long study of nuclear power programs in the U.S. and abroad and the consequent need for enriched fuel; the Forum recommends that the U.S. begin at once to construct uranium-enrichment plants that would cost $7 billion, pointing out that the AEC operates only 3 enrichment plants, which today supply most of the free world's uranium fuel for nuclear power, and stressing that "as nuclear power is growing, the uranium produced by these plants cannot carry us beyond 1977".

3080. "General Conference of the International Atomic Energy Agency Holds 16th Session at Mexico City", *U.S. Department of State Bulletin*, v. 67, no. 1741, 6 November 1972, pp. 539-542.

Presents a statement made before the conference by Dr. J. R. Schlesinger, Chairman of the Atomic Energy Commission, in which he reviews the efforts of the U.S. to develop an energy policy and to come to grips with the advantages and disadvantages of nuclear fission, and discusses the role of the International Atomic Energy Commission in seeing that nuclear energy is safely managed by those nations using it.

3081. Lewis, R. S., "Citizens v. Atomic Power", *New Scientist*, v. 56, no. 821, 23 November 1972, pp. 450-452.

Describes the questions raised by intervention of citizen groups in the AEC's reactor licensing process, i.e., questions concerning the right of an industrial establishment, particularly the nuclear power industry, to impose a new technology with unresolved health and safety problems upon a community without its consent, and the nonexistence of a long-range energy policy other than the nuclear policy of the Atomic Energy Commission; discusses the results of the environmentalist efforts, e.g., the establishment of stricter safety standards, and describes AEC reactions to citizen intervention in power-plant-licensing hearings.

3082. Gravel, M., "False Claim about Nuclear Electricity Referred to Federal Trade Com-

mission", *Congressional Record*, v. 118, no. 163, 11 October 1972, pp. S17462-17466.
Sharply criticizes a Westinghouse Corp. advertisement which claims that the nuclear breeder reactor "will produce essentially no radioactivity", and calls for a Federal Trade Commission investigation of the claim; presents 3 scientific papers (2 by Dr. J. W. Gofman, codiscoverer of the fissionability of uranium-233, the other by Dr. H. O. Alfen, winner of the 1970 Nobel Prize in physics), which refute Westinghouse's claim.

3083. Ramey, J. T., "New Concepts in the Siting of Nuclear Power Plants", *Congressional Record*, v. 118, no. 169, 18 October 1972, pp. E8820-8822.
Reviews the energy crisis facing the U.S. and the status of nuclear power; discusses some new concepts for nuclear-power-plant site complexes, including "energy centers", offshore sites, and power-plant parks, and briefly assesses the potential of new energy technologies such as fusion power, solar energy, geothermal energy, and tidal power.

3084. "Nuclear Interests Win Round in Battle Over Nuclear Safety", *Inside R&D*, v. 1, no. 32, 8 November 1972, p. 4.
Reports a finding of the Advisory Committee on Reactor Safeguards, a nongovernmental committee of experts, that the current design of power reactors "can be operated without undue risk to health and safety of the public", which represents an endorsement of the Atomic Energy Commission's criteria for emergency or back up cooling systems; the AEC, however, will continue to tighten up safety criteria for reactors.

3085. Gillette, R., "Reactor Safety: AEC Concedes Some Points to Its Critics", *Science*, v. 178, no. 4060, 3 November 1972, pp. 482-484.
Describes the AEC's more cautious stance regarding the adequacy of emergency core cooling systems; discusses new operating guidelines proposed by the AEC's regulatory staff, prompted by criticisms by safety researchers in national laboratories and by members of the Commission's staff [*SPR* 5(3): 2663-2667]; outlines the 3 main changes in the guidelines: (1) the maximum temperature that reactor fuel will be allowed to reach will be set on a "case-by-case" basis in which avoidance of embrittlement of the metallic fuel is to be the main concern; (2) in no case will reactor temperatures be allowed to exceed 2200°F, a reduction of 100° from the previous limit; (3) setting of the temperature limits for individual reactors is now supposed to take into account the likelihood that the closely packed fuel rods might swell from excessive heat during an accident.

3086. Ramey, J. T., "New Concepts in the Planning and Siting of Nuclear Power Plants", *AEC News Releases*, v. 3, no. 40, 4 October 1972, pp. 5-10.
Describes the factors contributing to the impending energy crises, and the power plant siting difficulties stemming from public concern over the environment as well as from growing competition for available land and water resources by other segments of our society; summarizes the present status of nuclear power, and discusses new concepts in the planning of power plants in terms of advances in nuclear technology, such as dual-purpose nuclear plants (for generating electricity and desalting saline water), and energy centers as agroindustrial complexes, offshore siting, and power plant parks; briefly describes advances in technology of energy fuels outside the nuclear field.

3087. Ramey, J. T., "Planning and Site Criteria: Keys to Solving the Power Plant Siting Problem", *AEC News Releases*, v. 3, no. 40, 4 October 1972, pp. 11-17.
Describes the dimensions of the siting problem and outlines a 4-point program proposed by the Federal Interagency Power Plant Siting Group for resolving the energy/environment conflict: (1) long-range planning of utility expansions on a regional basis at least 10 years ahead of construction; (2) participation in the planning by Government environmental agencies and private organizations and notice to the public of plant site locations at least 5 years in advance; (3) preconstruction review and approval of all large power facilities by a public agency at the state or regional level, or by the Federal Government if the states fail to act; and (4) an expanded program of research; describes siting legislation now before the Congress, and the role of R&D in resolving the problem.

3088. Lewis, R. S., "Bailing Out the Breeder", *Bulletin of the Atomic Scientists*, v. 28, no. 9,

November 1972, pp. 31-32.

Points out undesirable features of the AEC's commitment to the liquid-metal-cooled fast breeder reactor as the only means of resolving the U.S. energy crisis: (1) the AEC functions as both promoter and regulator of atomic power in onstruction of the $700 million LMFBR demonstration plant at Oak Ridge, (2) the taxpayer pays most of the bill and takes most of the risk against project failure, (3) the electric utility industry has little to lose if the demonstration program fails, and stands to gain "a great bonanza"; describes the Breeder Reactor Corp. (BCR) and Project Management Corp. (PMC) created to run the experiment.

3089. "Plowshare Prospects Survey", *Washington Science Trends*, v. 29, no. 8, 27 November 1972, pp. 43-44.

Presents opinions of participants in the American Nuclear Society Meeting held in Washington, D.C., in November, regarding the future of the "Plowshare" program; indications are that the energy-environment crisis will play a major role, but energy shortages could be the determining factor in bringing Plowshare "to market"; greatest interest now centers on vast supplies of natural gas for which such nuclear explosives may be the only effective method of extraction, but various attendees identified possible roadblocks: the availability of fissionable materials and vast legal problems stemming from environmental concerns; the International Atomic Energy Agency indicated a willingness to serve as an intermediary between potential suppliers of nuclear explosives and states which do not possess nuclear weapons, while the U.S. Atomic Energy Commission has supported legislation to put the Plowshare program on a commercial basis.

3090. "U.S. Nuclear Industry Demands Enrichment Data", *New Scientist*, v. 56, no. 822, 30 November 1972, p. 509.

Discusses a report by the U.S. Atomic Industrial Forum which draws attention to atomic energy-industry worries concerning the future ability of the present U.S. uranium-enrichment policy to meet the demands of both the U.S. and Europe; discusses the national security problems associated with development of an adequate policy, emphasizing that industrial incentive must not be hampered by unnecessary security restrictions to enlarge and improve the U.S. capacity to enrich uranium.

ENERGY RESEARCH

3091. Spencer, J. D., and Linville, B., *Bureau of Mines Energy Program, 1971*, U.S. Bureau of Mines Information Circular 8551, 1972, 102 pp. (Available from Publications Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh, Pa. 15213.)

Summarizes more than 100 basic and applied "clean energy" research projects conducted in 1971; describes various novel approaches to problems in energy production and use, as well as improvements in technology; includes an appendix which lists 201 publications associated with the work described in this report plus several publications issued before 1971.

3092. Hottel, H. C., and Howard, J. B., *New Energy Technology – Some Facts and Assessments*, M.I.T. Press, Cambridge, Mass., and London, England, 1971. (Clothbound, $10.00; Paperback, $2.95)

Describes the technological status of energy and fuel in the U.S., assesses the technical and economic adequacy of existing and proposed processes (and their consistency with developing standards of environmental quality), and suggests where additional effort – research, development, demonstration plant – is needed; examines most of the various methods of energy production now in use or likely to come into general use, including fossil fuel-to-fuel conversion, nuclear power, and central station power from fossil fuel, and provides background information on such relevant topics as energy transportation and storage and the prospects for using solar energy.

3093. *Patterns of Energy Consumption in the United States*, Office of Science and Technology, Executive Office of the President, January 1972, 220 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: $2.25.)

Presents the findings of a study conducted to provide detailed information on how

the U.S. uses its energy, dealing only with energy consumption in the recent past -- making no projections of energy demand -- and focusing primarily on the residential, commercial, and industrial sectors, with some attention to the transportation sector and efficiency of fuel utilization; according to the study, total system efficiency in the U.S. is quite low (15 to 50%); major findings include: (1) space heating for residential and commercial establishments is the largest single end use of energy other than transportation, with residential being the largest of the two; (2) air conditioning, while amounting to only 2.5% of total energy demand, has a growth rate of 10.2%/year; and electric space heating has an efficiency rating of 95%, if the conversion of fuel to electricity is discounted.

3094. "Center Views Energy Problems on Global Basis", *Chemical & Engineering News*, v. 50, no. 45, 6 November 1972, pp. 23-24.

Describes the activities of the National Center for Energy Management and Power which is committed not only to advancing the technology of energy conversion, but also to training people to manage effectively whatever form the energy industry assumes in the future; discusses a major task of the Center, viz., to examine both the social and technological impacts of energy production and utilization.

ENERGY – UNCONVENTIONAL SOURCES

3095. Cherry, W. R., and Morse, F. H., *Conclusions and Recommendations of the Solar Energy Panel*, Preprint of paper (No. 72-WA/Sol-5) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 12 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Identifies 3 areas where solar energy could supply significant amount of the U.S. energy need: (1) energy for heating and cooling, (2) the production of fuels, and (3) the generation of electrical power; describes the approximate state of development of the various solar utilization techniques, identifies the major problems to be overcome, and indicates the expected impact of solar energy applications; concludes that with adequate R&D support over the next 30 years, solar energy could provide up to (1) 35% of building heating and cooling needs, (2) 30% of the Nation's gaseous fuel, (3) 10% of the liquid fuel, and eventually (4) 20% of the electrical power needs of the U.S. -- all with a minimal effect on the environment and a substantial savings of nonrenewable fuels.

3096. Hammond, A. L., "Photovoltaic Cells: Direct Conversion of Solar Energy", *Science*, v. 178, no. 4062, 17 November 1972, pp. 732-733.

Evaluates the potential of solar cells for generating electricity for terrestrial use, and describes the applications being studied (e.g., a solar-powered house, a centralized generating station, and, in the long-term future, large orbiting power stations that would transmit energy back to earth); identifies the major hindrances to the use of solar cells in terrestrial applications, namely, the problems of reducing the cost of solar cell arrays more than 100-fold, increasing their useful lifetimes, and developing methods for the storage of energy; points out that although the development of photovoltaic power requires major federal funding, the potential resource is indeed large.

3097. Hammond, A. L., "Magnetohydrodynamic Power: More Efficient Use of Coal", *Science*, v. 178, no. 4059, 27 October 1972, pp. 386-387.

Describes the potential of magnetohydrodynamic (MHD) generators as an alternative means of converting coal to power; points out that the high efficiency attainable with this technology would lead to reduced consumption of fossil fuels and markedly reduced thermal pollution, and that this technology offers one of the best methods of eliminating sulfur oxide and reducing nitrogen oxide emissions from coal-fired power plants; describes the limited research being conducted, and the problems that remain to be solved, e.g., the economics of the process and the endurance of the generators (particularly their resistance to highly corrosive residues of combustion); suggests that efforts to improve the use of coal as / worthwhile, and urges increased Government support of research on MHD in the U.S.

3098. Maugh, T. H., II, "Fuel From Wastes: A Minor Energy Source", *Science*, v. 178, no. 4061, 10 November 1972, pp. 599-602.

Examines the feasibility of converting solid organic wastes into synthetic fuels, citing the major drawbacks: (1) the difficulties of marketing low-value energy resources; (2) the insufficient amounts of *suitable* waste materials available; (3) the difficulties of collecting sufficient quantities of waste to make operation of a conversion plant economically acceptable; and (4) a low fuel yield in terms of percentage of annual consumption; describes the development status and research being conducted on the 3 major conversion methods (hydrogenation, pyrolysis, and bioconversion), of which the hydrogenation process may show the most promise, although its economic feasibility remains to be determined; concludes that while conversion of organic wastes to fuels is an ideal means of waste disposal, it is probably an unfeasible means of averting an energy crisis.

3099. "Hydrogen Figures in Many Energy Proposals", *Chemical & Engineering News*, v. 50, no. 40, 2 October 1972, pp. 33-35.

Presents general data on costs of possible U.S. energy systems, and describes an energy system using hydrogen, called the Eco-Energy System (EES); outlines the alternatives (variants) used to study the economic viability of the EES, most of which use a nuclear power plant as the primary source of energy; the consensus among energy-system researchers is that hydrogen systems could someday be economically and ecologically superior to current energy systems.

3100. Maugh, T. H., II, "Hydrogen: Synthetic Fuel of the Future", *Science*, v. 178, no. 4063, 24 November 1972, pp. 849-852.

Assesses the potential of hydrogen, not as an alternative primary energy source, but as an energy carrier in situations where transfer of energy as electricity is inefficient, impractical, or impossible; describes the most promising areas of application, e.g., in transportation (automobiles and aircraft) and for transmission of energy over long distances; discusses the advantages, stressing the nonpolluting characteristic of hydrogen, and the high efficiency of hydrogen-fueled engines; considers some of the problems (e.g., those associated with storage of gaseous hydrogen and reducing the cost of liquid hydrogen), and examines some possible solutions.

3101. Lessing, L., "The Coming Hydrogen Economy", *Fortune*, v. 86, no. 5, November 1972, pp. 138-142, 144, 146.

Examines the potential of hydrogen as an energy source – a fuel which will be "relatively cheap, marvelously abundant, and entirely clean", and which might be in use within a decade; describes the possible applications (e.g., in the home, in the automobile, and in aircraft), and the barriers to its use – chief of which is the exaggerated fear of explosions; outlines the advances in hydrogen technology resulting from space R&D and discusses the problems that remain to be solved (e.g., high cost, fuel logistics, and storage).

3102. "A Permanent and Limitless Energy Source for the World", *Center Report*, v. 5, no. 4, October 1972, pp. 8-9.

Presents a report based on recent presentations of R. Ross (physicist at the Lawrence Livermore Laboratory, California) at the Center for Democratic Institutions; the report explains the nuclear fusion process and delineates its advantages: (1) the fusion process is kind to the ecosystem, since it produces no radioactive ashes, produces only minimal radiation, burns no fossil fuels, and releases no noxious products; (2) fusion fuel reserves are virtually inexhaustible; and (3) fusion could not be sabotaged; the report also suggests that a bold and decisive energy policy should put fusion as the next step *beyond* the fission reactor, supplementing it at the earliest possible date, and describes several alternatives for financing the multibillion dollar effort required to develop fusion energy.

ENVIRONMENT – BIBLIOGRAPHY

3103. *The Environmental Film Review: A Critical Guide to Ecology Films*, Environment Information Center, Inc., 1 September 1972, 155 pp. (Available from Environment Information Center, Inc., Film Reference Dept., 124 East 39th St., New York, N.Y.

10016. Price: $20.00.)

Consists of two major parts: A Review Section which contains all film reviews according to 21 major environmental categories, beginning with air pollution and ending with wildlife; and an Index Section which permits location of films by subject, industry, sponsor, and title; provides detailed information on use of the guide, which employs a star rating system (* = above average, ** = exceptional, a list of film distributors, and ordering information.

ENVIRONMENT — INTERNATIONAL COOPERATION

3104. *The UN System and the Human Environment,* Consolidated documents submitted by the Administrative Committee on Co-ordination (ACC) to the United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16 June 1972, 81 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22150. Price $3.00.]

Outlines the current environment-related activities of the U.N. system (in such areas as the planning and management of human settlements for environmental quality, the environmental aspects of natural resources management, and development and the environment) and gives examples of the trend toward multidisciplinary approaches; describes the environmental orientation of the U.N. system — the functions and perspectives; presents the ACC's conclusions, which include: (a) environmental issues are facets of development and the two should not be separated either in concept or practice; (b) there are important issues which at present are not covered, or are inadequately covered, and an integrated approach to many questions of the environment is needed; (c) an international approach to environmental questions depends on the political will and decisions of the Member States.

3105. *International Organizational Implications of Action Proposals,* Report of the Secretary-General to United Nation's Conference on the Human Environment, 5-16 June 1972, 39 pp. [Available by accession number (PB-211-133) from National Technical Information Service, Springfield, Va. 22151. Price: $3.00.]

Describes the need for new approaches to management of environmental problems, and presents 10 criteria for international organizational arrangements in the environmental field, such as: (1) "it is more logical to consider a network of national, international, functional, and sectoral organizations with appropriate linkages . . . than to think in terms of a global 'super agency' "; (2) "environmental problems and situations vary greatly among nations and any organization arrangements contemplated must necessarily bear this fact in mind"; outlines the new functions required at the international level, the broad institutional alternatives, and the requirements for and administration of international environmental funds.

3106. *International Organizational Implications of Action Proposals: Addendum No. 1: Views of the Preparatory Committee for the Conference,* Presented at United Nation's Conference on the Human Environment, 5-16 June 1972, 8 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22151. Price: $3.00.]

Reprints Chapter III ("International Organizational Implications of Recommendations for Action by the Conference") of the Preparatory Committee's report on the discussion at its 4th session, to facilitate consideration of this subject at the U.N. Conference; examples of the opinions expressed follow: members of the Preparatory Committee stressed the need to take into account the regional nature of many environmental problems and of the measures required to deal with them; there was general concensus on the need to establish, within the U.N., an intergovernmental body to provide broad and continuing policy direction for international cooperation in the field of human environment, and that it would be premature to define at that time the precise functions and terms of reference of that body, since such function would emerge from the recommendations of the Conference for action at the international level.

3107. *Identification and Control of Pollutants of Broad International Significance,* presented at United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16

June 1972, 101 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22150. Price: $3.00.]

Considers all aspects of pollution, examines the nature and extent of pollution problems in industrial and developing countries, tabulates the characteristics of major pollutants (including their effects on man and the environment), and identifies major pollution problems; outlines the areas where international cooperation in pollution control would be beneficial and the specific areas of needed action; offers 23 recommendations regarding actions to be taken by the governments of the Member States and by the organizations in the U.N. system, which underscore the importance of acquiring and disseminating knowledge for assessment of pollutant sources, pathways, exposures, and risks -- and the need for the development of monitoring and research programs to provide that knowledge.

3108. *Educational, Informational, Social, and Cultural Aspects of Environmental Issues*, Report of the Secretary-General to the United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16 June 1972, 36 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Spingfield, Va. 22150. Price: $3.00.]

Relates man's development with the desire for a decent environment, and describes the social and cultural roots of the environmental crisis; outlines the general manifestations of environmental problems (the ecological crisis, the population explosion, the deterioration of human settlements, etc.); defines the objectives of actions to improve the environment (e.g., to maintain and restore the biosphere, to improve the quality of life, to promote the development of the "whole man"); presents recommendations for national and international action, directed toward inclusion of environment-related subjects in school curricula, training of specialists in environmental management, and establishment of an international program of technical and financial assistance to further these aims.

3109. *Development and Environment*, Report of the Secretary-General to the United Nation's Conference on the Human Environment, 5-16 June 1972, 70 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22151. Price: $3.00.]

Presents a brief summary of the *Report on Development and Environment* (the "Founex Report") which resulted from a meeting of a panel of experts at Founex, near Geneva, 4-12 June 1971, and which essentially comprises a statement of environmental issues in the development process, particularly those of developing countries; offers recommendations for national and international action, directed toward the integration of environmental goals with development policies, and toward establishing an appropriate balance between environmental concerns and development, through assistance of the U.N. and other regional organizations in organizing research, in training personnel, in arranging for information exchange, and in providing increased technical and financial assistance; includes 3 annexes presenting the complete Founex Report, the general views of a Working Party on the chief environmental problems in developing countries, and a summary report on regional seminars on development and environment (held during August and September 1971).

3110. "U.S. and U.S.S.R. Sign Memorandum of Implementation of Environmental Agreement", *U.S. Department of State Bulletin*, v. 67, no. 1738, 16 October 1972, pp. 451-455.

Presents the text of the Memorandum signed at Moscow, September 1972, by representatives of the U.S. and the Soviet Union, providing for joint research in environmental areas such as air, water, and marine pollution, enhancement of the urban environment, effect of environmental changes on climate, and earthquake prediction.

3111. "Five-year Field Program to Establish a Satellite Geodetic Survey Network; Completed by U.S., Canada, and Great Britain", *U.S. Department of Commerce News*, Release NOAA 72-134, 11 October 1972, 2 pp.

Describes the highly accurate satellite geodetic survey network linking Canada with Alaska and the Continental U.S., established as part of a program to help modernize the present geodetic network dating back to 1927 and based on measurements made as early as the 1800's.

3112. Preiser, W.F.E., and Reagan, J. T. (Eds.), *Environmental Design Perspectives: Viewpoints on the Profession, Education and Research*, Man-Environment Systems: Focus Series, Association for the Study of Man-Environment Relations, Inc., and College of Architecture, Virginia State Polytechnic Institute and State University, 1972, v. 1, 151 pp. (Available from Association for the Study of Man-Environment Relations, Inc., P.O. Box 57, Orangeburg, N.Y. 10962.)

Presents articles by individuals associated with the College of Architecture at Virginia Tech, grouped into 3 topical domains: design education, professional practice, and environmental design; the first section deals with educational objectives and approaches in the Virginia Tech College of Agriculture; the second deals with such subjects as transportation, environment, urban growth policy, and computer-aided design; and the third deals with such topics as man-environment research and environmental design.

3113. Boyd, R., "World Dynamics: A Note", *Science*, v. 177, no. 4048, 11 August 1972, pp. 516-519.

Offers an alternative to Professor J. Forrester's computer-based predictions [see *SPR* 5(1):2042], which reveal that Forrester's world model is quite sensitive to changes in assumptions; starting with an essentially similar model but incorporating a "technology variable", a set of beliefs as to the effect of technological progress and assuming a quicker decline in population, produces an optimistic forecast: world population levels off at 15 billion within a century, progress in recycling technology halts the consumption of natural resources completely while there are still quite large reserves remaining, the quality of life begins to climb, and pollution never begins the rise predicted by Forrester's model; concludes that the *World Dynamics* simulation alone "is far from useful as a policy tool".

3114. Turk, A., Turk, J., and Wittes, J. T., *Ecology, Pollution, Environment*, W. B. Saunders, London and Toronto, 1972, 217 pp. (£1.70)

Examines the main types of pollution – agricultural, radioactive, thermal, noise, etc. – and the parts of the environment they affect – air, water, land, and people; explains in each case the necessary scientific basis, and uses everyday examples for illustrative purposes.

3115. Bourne, A., *Pollute and Be Damned*, J. M. Dent, London, 1972, 216 pp. (£2.95)

Examines the environmental damage going on in the world, which is in large measure the result of technological development; asks questions about the basic motives of man and his ingrained disregard of things environmental; concludes that man has not yet come to terms with his environment, nor with himself as an organism dependent on its environment.

3116. Beckerman, W., "Environmental Policy: The Contribution of Economics", *OECD Observer*, no. 60, October 1972, pp. 34-36.

Discusses the application of economic theory to identify (1) the sense in which pollution constitutes a problem and (2) the type of solutions which might be found, and offers some examples in specific areas; e.g. (a) the social costs of pollution, which are external to the polluters; (b) optimum choice in the rate at which society should discount the future, considering the long delay before the effects of pollution may be felt and the uncertainty about these effects; contends that almost all the major features of the environmental problem can be greatly clarified in the light of existing economic theory, although there are some difficulties that would have to be worked out.

3117. *Man's Impact on the Global Environment: Assessment and Recommendations for Action*, Report of the Study of Critical Environmental Problems (SCEP), MIT Press, Cambridge, Mass., 1970, 318 pp. ($2.95)

Summarizes the findings and specific recommendations developed by the various Work Groups of the Study concerning the climatic and ecological effects of man's activities and the implications of change and remedial action, and presents the reports of 7 SCEP Work Groups; also offers general recommendations, in brief: (1) the development of new methods for gathering and compiling global economic and statistical information; (2) a study of the possibility of setting up international

physical, chemical, and ecological measurement standards to be administered through a monitoring standards center; (3) an immediate study of global monitoring to examine the scientific and political feasibility of integration of existing and planned monitoring programs.

3118. *Planning and Management of Human Settlements for Environmental Quality*, Report of the Secretary-General to the United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16 June 1972, 40 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22150. Price: $3.00.]

Explains the need for action in the area of human settlements and identifies the objectives of such action, viz., to achieve minimum acceptable environmental conditions in such areas as shelter, employment, and fulfillment of biological, social, and cultural needs; emphasizes the need for a comprehensive approach to the settlements problem and examines the key aspects, including population growth and distribution, industry, transport, water supply, sewage and waste disposal, as well as health and well-being; offers recommendations for national and international action: e.g., adoption of a comprehensive environmental development approach; establishment of national population policies, land-use policies, etc.; the achievement of public participation in formulating and implementing such policies; establishment of international services and facilities to support action at the national level; and an international program for environmental improvement areas.

ENVIRONMENTAL AGENCIES

3119. Walsh, J., "U.N. Environmental Program: Despite Hitch, Coming on Strong", *Science*, v. 178, no. 4066, 15 December 1972, pp. 1183-1185, 1226.

Examines the underlying issues of the controversy between Maurice F. Strong (presumptive head of the new U.N. Environment Program) and the U.N. Secretariat, viz., questions about management of the Program and about control of the Environment Fund; reports that the controversy is now apparently settled and that Strong will be nominated as first secretary of the Environment Secretariat by U.N. Secretary General Kurt Waldheim; discusses other matters of concern, such as the proposed location of the Secretariat in Nairobi, Kenya, and the opposition of the U.N. specialized agencies who view the Environment Secretariat as a competitor for funds; describes the type of assistance that the Secretariat is likely to give individual countries, stressing that the focus will be "global environmental problems" – that is, problems that transcend national boundaries.

3120. "EPA Moves to Upgrade R&D Management", *Chemical & Engineering News*, v. 50, no. 51, 18 December 1972, pp. 14, 16.

Discusses a General Accounting Office study which sharply criticizes the Environmental Protection Agency's and predecessor agencies' management of Federal R&D and demonstration programs for curbing water pollution; for example, GAO noted that millions of dollars earmarked for demonstrating new or unproved waste-treatment methods have been spent instead for demonstrating "new" uses of technology that has been in widespread use for many years; GAO also cited unwarranted delays in approval or denial of new or ongoing projects, inadequate project monitoring, and delays in disseminating project reports; points to EPA's efforts to implement GAO recommendations with significant progress already made.

3121. "EPA Assesses Pollution Control Benefits", *Environmental Science & Technology*, v. 6, no. 10, October 1972, pp. 882-883.

Describes the organization of the Environmental Protection Agency's Implementation Research Division (IRD), and its purpose: "to carry out an interdisciplinary multimedia program of studies that will help EPA implement its environmental protection responsibilities"; delineates tasks of IRD's 4 branches: (1) the Economic Analysis Branch is charged with finding ways to pin down the costs and benefits of pollution control; (2) the Ecological Studies & Technology Assessment Branch concentrates on research needed by EPA to evaluate environmental impact statements; (3) the Standards Research Branch works on the development of better methodology for evaluating environmental standards; (4) the Systems

Evaluation Branch identifies incentives and related fiscal inducements to promote pollution control.

3122. *EXPRO '73, Office of Research and Monitoring Extramural Program Information Bulletin, Fiscal 1973*, Office of Research and Monitoring, Environmental Protection Agency, October 1972, 253 pp. (Available from Resource Management Branch, Office of Research and Monitoring, U.S. Environmental Protection Agency, Washington, D.C. 20460.)

Presents general guidelines for developing grant or contract projects, briefly describes the Office of Research and Monitoring's grant and contract activities, offers guidelines for submission of grant applications or contract proposals, and provides a comprehensive listing of research, development, and demonstration projects planned for funding during FY 1973, grouped according to various program areas such as health effects, ecological effects, transport processes, applied science and technology, and solid waste technology.

ENVIRONMENTAL LEGISLATION

3123. Walsh, J., "Environmental Legislation: Last Word from Congress", *Science*, v. 178, no. 4061, 10 November 1972, pp. 593-595.

Describes some of the major provisions and controversial features of environmental control bills passed shortly before final adjournment of the 92nd Congress; the major bill is the Federal Water Pollution Control Amendments, which brings about a shift in enforcement criteria from water-quality standards to effluent limitations; ranking next is the Federal Environmental Pesticide Control Act (with a $24.6 billion authorization) which includes a provision for government reimbursement of manufacturers or any others holding supplies of a dangerous pesticide banned from the market – a provision which environmentalists feel will inhibit use of the suspension mechanism to protect public health and the environment and will prevent enforcement of the law; other last-minute legislation includes a coastal-zone management bill, a law to regulate ocean dumping, and a noise control act.

3124. Hollings, E. F., "The National Coastal Zone Management Act", *Congressional Record*, v. 118, no. 165, 13 October 1972, pp. S17875-17876.

Describes chief provisions of the National Coastal Zone Management Act, S. 3507, which will provide up to $200 million over the next 5 years to help the states protect, preserve, and restore the quality of their coastal areas; the Act, which is designed to complement the proposed National Land Use Policy Act also provides states with national policy goals to control those land uses which have a direct and significant impact on coastal waters.

3125. "Water Pollution Law – 1972 Style", *Environmental Science & Technology*, v. 6, no. 13, December 1972, pp. 1068-1070.

Describes the costly Federal Water Pollution Control Act Amendments of 1972, passed over the President's veto and modeled closely after the clean air bill, including an $18 billion authorization over the next 3 years for publicly owned waste treatment works – 3 times more than that requested by the President for the same time period; presents calendars and tables depicting standards and pollution level schedules through FY 1983 and authorizations through FY 1975 under the new act (P.L. 92-500).

3126. Barfield, C. E., "Water Pollution Act Forces Showdown in 1973 Over Best Way to Protect the Environment", *National Journal*, v. 4, no. 5, 9 December 1972, pp. 1871-1882.

Examines the policy issues engendered by a last-minute amendment to the Water Pollution Control Act of 1972, which exempted the Environmental Protection Agency (EPA) from filing impact statements on most actions it will take under the new water bill: (1) whether EPA is bound by the National Environmental Policy Act (NEPA) requirement for impact statements from all Federal agencies; (2) whether NEPA, which has been used to challenge dozens of Federal projects, should also be available to challenge specific pollution controls that Congress has mandated; presents the arguments for and against the amendment (by agency heads, environmentalists, industry, members of Congress, et al.), and describes the

bases for these arguments.

3127. *In Productive Harmony*, U.S. Environmental Protection Agency, September 1972, 13 pp. (Available from EPA, Office of Public Affairs, Washington, D.C. 20460.)

Defines the purpose, content, and form of environmental impact statements as required by the National Environmental Quality Act (NEPA); describes how and when the statements are to be made, the role of the Council on Environmental Quality, and EPA's impact-statement review process; reviews legal actions and court decisions concerning violation of NEPA's Section 102(2)(C).

3128. Gage, S. J., *Impact of Environmental Statements on Consideration of Nuclear Power as a Resource Alternative*, Preprint of a paper (No. 72-WA/NE-6) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 9 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Presents a brief history of the National Environmental Policy Act of 1969, and traces the evolution of its "alternatives" section in Congress and in the courts; describes the events leading to court action against the Department of Interior for failure to comply with the "alternatives" section of the Act; discusses the impact of the court's decision in that case (viz., "that Federal agencies must consider not only the alternatives but also the environmental impacts of those alternatives") and the impact of other court actions on the content of major energy-related environmental statements released by the Interior Department and the AEC during 1972.

EUROPE

3129. "For A 'European' Science and Technology Policy", *Embassy of Switzerland Bulletin*, v. 12, no. 3, November 1972, pp. 31-33.

Presents comments concerning the urgent need for a common European science policy, for example: "the coordination and promotion of scientific research and technological development, at Community level, should indeed be one of highest priorities of the enlarged Community"; "A gradual awakening to the inadequacies of technological development . . . has recently caused social demands to be slanted towards R&D goals capable of better meeting the social needs shared by European countries (health, transport, telecommunications, etc.); "in order to cope with these varied needs . . . the Member Countries . . . will find it advantageous to pool their efforts in the R&D field"; stresses the Community's need to provide itself with the machinery to shape the decisions that will form the common R&D policy and the organs and resources necessary to implement them.

3130. *European Scientific Cooperation: Priorities and Perspectives*, Science Policy Studies and Documents, Unesco, no. 30, 1972, 32 pp. (Available from Unesco Publications Center, P.O. Box 433, New York, N.Y. 10016. Price: $2.50.)

Describes the organization of the Budapest Meeting of the Committee of Governmental Experts on Science Policy selected by the Governments of the European member states of Unesco; presents the Preamble (which includes a tentative list of the promising areas and possible modalities for cooperation) and the 5 specific recommendations adopted by the Committee, which deal with: (1) the prospects for further European science cooperation; (2) the planning aspects of science policy-making; (3) the management aspects of science policy-making and the efficiency and effectiveness of R&D; (4) the forecasting aspects of science policy; and (5) the international exchange of data on the profile of R&D effort in European Member States.

3131. "Upheaval Ahead for the European Community", *Nature*, v. 239, no. 5371, 6 October 1972, pp. 297-298.

Considers the management changes that may result from enlargement of the European Community in January 1973; cites the failure of Euratom and the inadequacy of present arrangements for a common agricultural policy as examples of the shortsightedness and mismanagement on the part of the bureaucracy in Brussels; stresses the need for a common R&D policy, agreement on technical objectives, coordination, and common planning, to assure orderly development of,

for example, an integrated telecommunications network and a common energy program for Europe.

3132. Friborg, G. (Ed.), *Science Research Councils in Europe*, Report of the Conference of West European Science Research Councils, held at Aarhus, Denmark, 9-11 February 1972, 301 pp. (Available from NFR, Editorial Service, Wenner-Gren Center, Box 23136, S-104 35 Stockholm 23, Sweden. Price: $6.38.)

Reviews the activities of the councils, and presents papers delivered at the conference which provide: (1) brief analyses of the councils from administrative, scientific, and science policy points of view; (2) assessments of the role of the councils today and in the 1970's with special reference to their significance for the universities, research institutes, and the community at large; and (3) an analysis of the scientific and practical aspects of collaboration among these councils today and in the future; includes an appendix which describes the organization of the councils.

3133. "Common Market Expands Support for R&D", *Industrial Research*, v. 14, no. 1, October 1972, p. 24.

Describes a new joint science and technology policy adopted by the Common Market, which is designed to provide financial and other aid in fields ranging from pure research to technical innovation, and which calls for the establishment of a European Research and Development Agency whose top-priority task will be to underwrite industrial innovation and development projects, starting in early 1973.

3134. "Eurogroup Defense Spending Up by $1.5 Billion for Coming Year", *Aviation Week & Space Technology*, v. 97, no. 24, 11 December 1972, p. 22.

Describes the concern that prompted an increase in defense spending for 1973 by 10 of the European members of the 15-member North Atlantic Treaty Organization, namely, that too large a portion of the total defense dollar is being spent on yearly operating costs, and too little on investments in modern equipment; a large portion of the increased funding will be spent for significant aircraft and missile procurements; the countries comprising the Eurogroup are the U.K., Italy, Belgium, West Germany, The Netherlands, Denmark, Greece, Luxembourg, Norway, and Turkey.

3135. "How to Find a European Space Policy", *Nature*, v. 240, no. 5376, 10 November 1972, pp. 61-62.

Discusses the barriers to a common space policy for Europe, among which are: (1) disagreement on the need for an independent launching facility; (2) mistrust in the U.S. offer to provide launching facilities for satellites manufactured elsewhere since it is subject to the approval of Intelsat; (3) European governments' inability to handle simple administrative problems, e.g., the joining of the European Space Research Organisation (ESRO) and the European Launcher Development Organisation (ELDO); suggests that ESRO and ELDO be completely merged, rather than merely united, and that member countries be compelled to agree that membership would forbid contracting out parts of the program with which they did not agree; stresses that without a thorough, independent study of the basis on which a program of work might be established — and political approval of the completed study — a European space program is not likely to emerge.

3136. "Progress at Last", *Nature*, v. 240, no. 5377, 17 November 1972, p. 122.

Discusses a proposal made at a meeting of European aerospace ministers to create a European Space Agency which would be responsible (1) for running all the space projects that come under the European Launcher Development Organisation and the European Space Research Organisation (ESRO), (2) for running each country's national program, and (3) for any European involvement in the post-Apollo project; also announces plans for ESRO to implement Phase B of the industrial studies for the post-Apollo sortie laboratory, with West Germany, Belgium, Italy, and Spain indicating a willingness to finance this stage of the studies.

3137. "Post-Apollo Participation Still in Doubt", *Nature*, v. 240, no. 5386, 10 November 1972, pp. 64-65.

Assesses prospects of Europe's involvement in the U.S. space program, as well as the future of the European Launcher Development Organization (ELDO); notes the lack of agreement concerning ELDO, (1) with Britain and Germany leaning

toward purchase of American launchers — in view of failure of ELDO's Europa program, (2) with Germany urging abandonment of the program in favor of participation in the U.S. program, and (3) with France insisting on development of European launch facilities; estimates initial cost of European participation should be about £250 million in order to be effective, which would preclude continued support for ELDO; emphasizes that with each delay in reaching a decision, the extent of European participation designated by NASA becomes smaller.

3138. Klass, P. J., "OTP Proposes ESRO Pick U.S. Aerosat Partner", *Aviation Week & Space Technology*, v. 97, no. 16, 16 October 1972, p. 16.

Examines the possible implications of the Office of Telecommunication Policy's (OTP) endorsement of negotiations on an aerosat arrangement between the European Space Research Organization (ESRO) and the Communications Satellite Corp., or with any other U.S. company interested in such a partnership; OTP officials believe the endorsement got the stalled aerosat program going again; some industry and government observers, however, believe that OTP has strengthened the bargaining position of ESRO on the production-sharing ratio for the space-borne portion of the aerosat system, and that ESRO might demand a 50/50 production sharing as the price of acceptability of a U.S. partner.

3139. "Overseas Competition Ganging Up", *Astronautics and Aeronautics*, v. 10, no. 11, November 1972, pp. 14-15.

Presents highlights of a report by an export committee of the Common Market; of chief concern to the U.S. is the committee's recommendation for establishment of a single aircraft-engine enterprise in Western Europe and two enterprises producing airframes with the aim of supplying European requirements with European aircraft and giving U.S. manufacturers more competition worldwide; government subsidies for aircraft production is urged, but the exact amount of government participation in these evolving aircraft and airframe enterprises has yet to be determined; the committee also recommends that the Community encourage and finance a judicious program of applied research related to overall civil aviation needs.

3140. "European Energy Policy: Difficult Political Problems Posed", *Science Policy*, v. 1, no. 6, November/December 1972, pp. 1.5-1.6.

Presents views expressed by G. de Carmoy in his paper on "The Politics of European Energy Policy"; according to de Carmoy, "perhaps of even greater concern [than energy needs and how to meet them] are the political problems implicit in proposals for the emergence of a realistic European energy policy from the collection of widely differing national policies that now exist"; a large part of de Carmoy's paper is devoted to presentation of basic statistics relating to the contribution that is being made, or could be made, by various forms of energy (e.g., coal, gas, nuclear) in terms of size, capital, and control, which de Carmoy believes is prerequisite to the definition of policy goals as may be occasioned by technological and geopolitical considerations; de Carmoy briefly surveys the energy policies of the main European industrial countries, and concludes that Britain has the most favorable energy balance sheet, while France has greater control, i.e., the government controls the entire energy sector.

3141. Verguèse, D., "Europe and the Environment: Cooperation a Distant Prospect", *Science*, v. 178, no. 4059, 27 October 1972, pp. 381-383.

Describes unsuccessful efforts to develop a common environmental action program for Europe by supranational institutions, including NATO and OECD as well as the 3 European Communities — the EEC, ECSC (the European Coal and Steel Community) and Euratom; discusses the factors which act as stumbling blocks to any common European policy (e.g., nuclear or space): reluctance of countries like France and Britain to participate fully in the work of OECD and NATO; dissension within the ECC between the commission (the executive body of the 3 European communities) and the council of ministers (the "watchdog" of national interests and independence; lack of common air and water-quality standards among countries.

3142. "Rhine-Basin Countries Vow to Clean Up River", *Chemical & Engineering News*, v. 50, no. 47, 20 November 1972, pp. 8, 11.

Describes the increasing pollutant levels of the Rhine River, and the actions to

correct the situation promised by the 5 countries served by the Rhine (France, W. Germany, Luxembourg, the Netherlands, and Switzerland), at a meeting called by the Netherlands' government; these countries also requested that the international Rhine protection commission draw up a list of chemicals that either should be banned from the river or be subject to controls.

3143. Orski, C. K., "The Future of European Intercity Transport", *OECD Observer*, no. 60, October 1972, pp. 27-33.

Describes European countries' plans for large-scale program to improve and expand their intercity transportation systems, which include improvements in rail service, construction of modern super highways, and the building of new airports as well as expansion of existing air terminals and aircraft fleets; illustrates the comparative advantages of different transport modes, and describes several transportation systems being considered (e.g., advanced high-speed rail systems and unconventional ground transportation systems); stresses the need for a balanced *and* integrated transport system for Europe as a whole.

3144. "European Molecular Biology Laboratory", *Science Policy*, v. 1, no. 5, September/October, p. 3.3.

Announces a decision to establish the Laboratory, reached at a session of the intergovernmental organization for coordinating European research in molecular biology (European Molecular Biology Conference established in 1970); delegates from Austria, France, Germany, Israel, Netherlands, Sweden, Switzerland, and the U.K. immediately announced their governments' intention to participate, Denmark and Italy expressed support but were unable, as yet, to signify their assent, while Greece, Norway, and Spain announced that they would be unable to join in the beginning; principal tasks of the Laboratory (to be located at Heidelberg, Germany, with two out-stations at Research Centers in Hamburg and Grenoble) will concern the development of instrumentation for molecular biology research, and providing a center at which scientists can undertake such research as visitors.

FINLAND

3145. Kaurnen, P., and Linna, M., "Science Policy and International Research Cooperation in Finland", *Science Policy*, v. 1, no. 5, September/October 1972, pp. 1.1-1.2.

Discusses the distribution of research input in Finland, which amounted to about 300 million marks in 1969 (divided roughly on a 50/50 basis between the public and private sector) and is estimated at about 380 million marks in 1971; describes Finland's science policy program which is focused on increase of the research input, the increase of planning, the development of research conditions at institutes of higher education, the improvement of scientific information services, and the increase of international research cooperation, and also emphasizes the need for increased input in technological research; summarizes current efforts in international research cooperation and outlines future prospects.

3146. "Finland: Increased Research Expenditure", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.3.

Presents highlights of the Finnish Industrial Board's program, which predicts that technological research financed by public funds will be considerably increased in the period 1971-80; emphasizes the role of efficient technological R&D of new products and production methods in securing economic growth and international competitiveness; proposes a 15 to 16%/yr increase in government funds for research in the 1970s, which would raise Finland's research input from 0.9% of GNP in 1970 to 1.8% by 1980.

FORECASTING

3147. Martino, J. P., "The Role of Forecasting in Technology Assessment", *The Futurist*, v. 6, no. 5, October 1972, pp. 210-211.

Explains the kinds of technological forecasts required to carry out each of the procedural steps for technology assessment: (1) identifying and refining the subject to be assessed; (2) delineating the scope of the assessment and developing the data

base; (3) identifying alternative strategies to solve the selected problems with the technology; (4) identifying the parties affected by the selected problems and the technologies; (5) identifying the impacts on the affected parties; (6) evaluating or measuring the impacts; and (7) comparing the pros and cons of alternative strategies; concludes that "only through technological forecasts can . . . benefits and costs be identified early enough that there is still time to make a meaningful choice".

3148. Khol, R., "What Good is Technological Forecasting?" *Machine Design*, v. 44, no. 30, 14 December 1972, pp. 114-120.

Identifies two basic forecasting techniques: trend extrapolation and its subsets (such as envelope curves, growth analogy, etc.) and Delphi, which is simply someone's subjective opinion of what will happen; defines 2 forecasting classifications: exploratory and normative; presents the differing views as to the value of forecasting (ranging from "it's a waste of time" to "it's the greatest) and as to the best methodology (with military forecasters favoring trend extrapolation, industrial forecasters favoring Delphi, and others favoring a combination of methodologies); other views expressed emphasized the need for technology assessment, which would require forecasting.

3149. Salancik, G. R., "Choosing Technology for a Better World", *The Futurist*, v. 6, no. 5, October 1972, pp. 208-209.

Discusses the 250 responses received to a questionnaire prepared by the Institute for the Future requesting members of the World Future Society to rate 12 technological developments according to desirability, and to judge how they would affect 10 selected values; high on the list of desirable developments are cheap and clean electrical power from thermonuclear plants, increased world agricultural production, and mass economic fertility control agents in water and food; these were deemed to contribute mostly to such values as a prosperous life, family security and care, and accomplishment.

3150. *Perspectives on Benefit-Risk Decision Making*, Report of a Colloquium Conducted by the Committee on Public Engineering Policy, National Academy of Engineering, 26-27 April 1971, National Academy of Engineering, 1972, 157 pp. (Available from Committee on Public Engineering Policy, National Academy of Engineering, 2101 Constitution Ave., Washington, D.C. 20418.)

Identifies the categories of decision making discussed at the Colloquium: (1) risks determined by individual option (e.g., sports, smoking, use of seat belts); (2) risks determined by individual option somewhat limited by governmental action (e.g., medical use of drugs, building codes, safety regulations); (3) risks determined by governmental action (e.g., air pollution, nuclear energy) -- the category of most interest to participants; presents the 14 papers submitted to the Colloquium, which cover such topics as: benefit-cost analysis in sociotechnical systems; legal mechanisms for risk-benefit analysis; risk, safety, and the role of government; and economic factors in benefit-risk decision making; includes a bibliography.

FOREIGN AFFAIRS

3151. *Second Consolidated Plan for Foreign Affairs Research*, Prepared by the Subcommittee on Foreign Affairs Research on the NSC Under Secretaries Committee (USC/FAR), August 1972, 61 pp. (Available from Office of External Research, U.S. Department of State, Washington, D.C. 20520.)

Describes the USC/FAR research objectives, which include: (a) improve the bases of choice in foreign affairs; (b) improve external foreign affairs research on the People's Republic of China by increasing the exchange between the government and the academic community; (c) develop common approaches for USC/FAR Member Agency support of policy studies with multiagency interest; (d) improve Government support for the USC/FAR Member Agency use of Soviet studies conducted in the private sector; presents an overview of the plan for FY 1972-73, by regions, functions, types of research, and purposes of research, as well as the overall funding levels.

3152. Weintraub, S., "Foreign Private Investment and Development", *U.S. Department of*

State Bulletin, v. 67, no. 1745, 4 December 1972, pp. 657-660.

Quotes an $86 billion book value of U.S. investments abroad, the rate of growth over the past 4 years being 32.7% for the developed countries and 26.9% for the developing countries; points out that U.S. policy is to encourage investment *only where it is wanted* and to promote settlement of the inevitable investment disputes by impartial procedures rather than by host-government appeals to nationalistic emotion; states the U.S. philosophy that private investment can promote development, and offers rebuttals to 8 specific arguments against investment in developing countries.

FRANCE

3153. "Closing the Purse Strings", *Nature*, v. 240, no. 5386, 10 November 1972, p. 64.

Describes those areas of French scientific research affected by government plans to trim the 1973 budget of the 5-year plan for scientific research; reports that both basic research and medical research faired well, especially in regard to funds allotted for equipment, while the budget for the programs of high technology was raised only slightly, and the budget for the aid to development programs, designed to bolster industrial research, is to be cut from Fr. 210 million in 1972 to Fr. 154 million in 1973.

3154. "French 'Concerted' Research Activities", *Science Policy*, v. 1, no. 6, November/December 1972, p. 3.4.

Describes France's "concerted activities", which constitute a special form of government assistance to research, and their purpose — to promote fundamental and applied research in a few priority sectors, in particular, by the award of research contracts to public and private laboratories; points out their chief advantage, viz.: (1) they permit a flexible and rapid form of finance and escape the rigidity and slowness of administrative and budgetary procedures; and (2) they serve as a "base" of coordination and cooperation between ministries, private and public laboratories, and among disciplines.

3155. "French Studying New Launcher", *Aviation Week & Space Technology*, v. 97, no. 24, 11 December 1972, p. 19.

Describes research being carried out by the French government on a new 3-stage launcher design which it will propose as the standard European launcher vehicle if the Europa launcher program is dropped by the upcoming European Space Conference; describes the components of the new vehicle which officials say will require a 7-year development period, and would probably be operational around 1979.

GOVERNMENT-SCIENCE INTERACTION

3156. Esch, M. L., "The Scientific Community and the Federal Policymaking Process", *Congressional Record*, v. 118, no. 162, 10 October 1972, pp. E8464-8466.

Discusses two key issues facing the scientific community and the Congress: the need for more effectively integrated inputs from the scientific community, and the need to reallocate R&D in favor of civilian technology; emphasizes the need for a coherent national policy to deal with these issues.

3157. Logsdon, J. M., "Towards a New Policy for Technology: The Outlines Emerge", *Technology Review*, v. 75, no. 1, October/November 1972, pp. 36-42.

Reviews past U.S. technology policy, and describes the bases for current concern of the Government with that policy: (1) the belief that Federal R&D should be more relevant to domestic problems, and that the civilian agencies of the Government should thus bear a much larger share of the Federal R&D budget; (2) the conviction that there is a definite link between investment in R&D and increases in productivity, successful international economic competition, and new employment opportunities, and that the U.S. is underinvesting in industrial R&D; outlines the new technology policy, which calls for a closer linking of Federal R&D with national goals and priorities, i.e., better application of U.S. scientific resources in meeting civilian needs through "a new partnership . . . one which brings together the Federal Government, private enterprise, state and local governments, and our

universities and research centers . . .".

3158. *The National Technology Program: Utilization of Industry*, Aerospace Research Center, Aerospace Industries Association of America, Inc., December 1972, 28 pp. (Available from Aerospace Research Center, Aerospace Industries Association of America, Inc., 1725 De Sales St., N.W., Washington, D.C. 20036.)

Presents brief rundown of the forces leading to the recent decline in U.S. Government support for R&D, its impact, and the Government's efforts to determine the role of technology in satisfying national economic and social needs; summarizes President Nixon's message on the importance of science and technology, providing both commentary and analysis; discusses the 3 basic economic problems identified by the President (international trade, productivity, and employment) from the viewpoint of realizing the potential economic contribution of industrial technology; examines means to utilize industry in solving these problems, identifying the barriers and ways to reduce or eliminate them; discusses 3 major cases where excessive Federal legislation is currently acting as a barrier to private innovations; offers detailed recommendations in each area, as well as broad policy recommendations.

3159. Lyons, R. D., "Science Adviser to Nixon Leaving for Industry Job", *New York Times*, 3 January 1973, pp. 1, 25.

Announces the resignation on January 2, 1973, of Dr. Edward E. David, Jr., President Nixon's Science Adviser, after 28-1/2 months in that post; gives the probable reason as David's disappointment at not being permitted to influence Federal R&D policy in any substantial way; cites reports that "a realignment of the Office of Science and Technology and other high-level technical groups is in the offing".

3160. "Senator Kennedy Strengthens His Influence", *Nature*, v. 240, no. 5375, 3 November 1972, pp. 6-7.

Discusses the factors that have, over the last 4 years, enabled Senator Kennedy to amass considerable influence over science policy in the U.S.: e.g., appointments to chairmanship of committees that have given him a strong voice in scientific legislation; notes that Kennedy's influence over congressional science affairs was increased even further with his appointment to the Board of the Office of Technology Assessment, and reports that Kennedy's chief preoccupation in 1973, aside from getting the OTA moving, will be with the National Science Policy and Priorities Act, which was passed by the Senate in 1972 but failed in the House of Representatives.

3161. Lewis, H. J., "Kennedy's Bill on Civilian Science, or How to Square the Pentagon", *sppsg Newsletter*, v. 3, no. 8, October 1972, pp. 1-4.

Presents opposing views on Bill S. 32 ["The National Science Policy and Priorities Act of 1972", see *SPR* 5(3):2744 and 2745], expressed by E. E. David, Jr. (presidential science adviser and director of the OST), H. G. Stever (director of NSF), P. Handler (president of NAS), R. W. Heyns (vice president of NSB), and several members of Congress; opposition to the bill centered chiefly on the huge transfer of authority that it entails (from OMB to NSF) and concerns over the redirection of NSF efforts from basic to applied research; views ranged from: the present system of decentralized R&D in the responsible departments, with leadership from OMB and OST, is "on balance the best solution", to "NSF is a reasonable locus" for research in civil science areas, to suggestions for creation of an entirely new agency for civilian-oriented research.

3162. "Economic Conversion Bill Causes NSF Split", *Chemical & Engineering News*, v. 50, no. 41, 9 October 1972, p. 14.

Presents conflicting views of the National Science Foundation's management (in effect the Nixon Administration) and the National Science Board (NSF's policy-making group) on the merits of Sen. E. Kennedy's economic conversion bill (S.32); in testifying at house hearings, NSF director Stevens asserted that S.32 isn't needed because programs already exist at NSF, and elsewhere in the Government, to do much that S.32 proposes; while NSB vice-chairman Heyns indicated that NSB would have no violent objection to enactment of S.32 if provisions were made to ensure that NSF's basic science obligations would not be jeopardized.

3163. "ACS Takes a Stand on the Economic Conversion Bill", *Chemical & Engineering News*, v. 50, no. 4, 9 October 1972, p. 7.

Cites a statement by American Chemical Society president M. Tishler which confirms the Society's support of the House version of the "National Science Policy and Priorities Act of 1972", particularly the provisions calling for increased Federal funds for R&D, aid to unemployed chemists, and the protection of the pension rights of scientists and engineers.

3164. "Need R&D Incentives, Removal of Antitrust Constraints to Regain Technological Lead", *Research/Development*, v. 23, no. 11, November 1972, p. 8.

Presents highlights of an address by Stanford Research Institute president C. A. Anderson before the Town Hall of California; the SRI head blames the growing antiscience and technology feeling in America for the loss of technological momentum or commitment to R&D and the resulting decline of U.S. technical superiority; suggests tax incentives to stimulate the flow of additional money toward research, and calls for major-scale Government contracting directly with American industry for R&D as a means to hasten solution of technology-based problems; encourages reexamination of the prevalent business attitudes which indicate a reluctance to take part in nonproprietary technological projects; warns that more R&D is essential if the U.S. is to maintain its technological leadership in today's fast-moving and changing world.

3165. "Scientific-Industrial Complex", *Industrial Research*, v. 14, no. 13, December 1972, p. 27.

Presents the views of C. Anderson, president of Stanford Research Institute, regarding industrial R&D; Anderson emphasizes that "without the establishment of a scientific-industrial complex, the U.S. faces a steadily worsening trade balance in future decades with dire results for the domestic economy", and suggests that a major realignment is required in the relationship of the U.S. Government and industrial R&D; he advocates such steps as: (1) significant tax benefits for investment in R&D; (2) increased direct contacts between government and industry for R&D needed to solve national problems (including the energy problem); and (3) relaxation of antitrust prohibition against appropriate forms of cooperation in R&D.

3166. "Industry to Have Stronger Voice in Federal Policy on Science and Technology", *Inside R&D*, v. 1, no. 30, 25 October 1972, p. 1.

Discusses the implications for industry of the establishment of the new Science and Engineering Council headed by Bill Baker, president of Bell Laboratories; the Council will effectively replace the existing Science Advisory Committee, which is heavily oriented toward academic goals, and will act as a pipeline to the White House on needs and problems of industrial R&D; in addition, the Office of Science and Technology is likely to be overshadowed by the council, particularly since its head, E. E. David, has resigned from OTS to accept a university post.

3167. "Congress Takes a Tougher Stance on Advisory Committees", *sppsg Newsletter*, v. 3, no. 8, October 1972, pp. 4-5.

Discusses provisions of the Federal Advisory Committee Act (passed 9 November 1972), which are much firmer than those of Executive Order 11671 [*SPR* 5(3):2755]; the Act calls (1) for the President to respond publicly to the recommendations contained in the public reports of presidential advisory committees; (2) for the listing of all reports submitted by all Government advisory committees, unless otherwise expected; and (3) for all meetings, unless exempted by the provisions of the Freedom of Information Act, to be open to public participation; the Act does not apply "to persons or organizations which have contractual relationships with Federal agencies, nor to advisory committees not directly established by or for such agencies".

3168. Werner, J., "Science, Business and Government: The Chemistry Can be Right", *Vital Speeches of the Day*, v. 39, no. 3, 15 November 1972, pp. 87-89.

Describes the need for government and business to employ science more effectively and more productively in determining priorities and formulating solutions for the vast problems facing the U.S. and the world; asserts that without science and technology we will be unable to solve such urgent questions as those concern-

ing environmental life support systems in ecology, depletion of material and energy resources, the use of nuclear energy, housing, and transportation; discusses the urgent need to provide the President, the Cabinet, and the Congress with a sound understanding of the scientific aspects of the gamut of recommendations they receive and the decisions they must make, and proposes establishment of a Technical Council which would operate at the interface of government and industry.

3169. "Proposed Technology Council Would Aid in Decision-Making Processes", *Inside R&D*, v. 1, no. 29, 18 October 1972, p. 3.

Announces a plan to make technical expertise of major industries available to government, set forth by J. Werner, president of GAF Corp. (New York, N.Y.); Werner proposes a Technology Council, made up of Chief executives of Technology-based companies, which would operate at the interface of government and industry to aid in decision-making processes, and to help government solve problems arising from technology.

3170. Shapley, D., "Science Shuffle", *Science*, v. 178, no. 4065, 8 December 1972, p. 1077.

Outlines the major moves likely to be suggested by the Nixon Administration in an attempt at major government reorganization: (1) transfer of some AEC activities (notably the civilian power program and programs on nonnuclear sources of energy) to some other organization with overall responsibility for a national energy program, which is to be placed under the proposed Department of Natural Resources (DNR); (2) placement of the NOAA under DNR's purview; of most interest to government scientists is the make-up of the proposed departments, with: (1) environmental, geophysical, and energy research being grouped under the DNR; (2) efforts in health, education, and occupational safety under the Department of Human Resources; and (3) materials research, industrial process standards, innovation encouragement, and technical information dispersal under the Department of Economic Affairs.

3171. *The President's Proposals for Executive Reorganization: Reform/Renewal for the 70's*, The Domestic Council, Executive Office of the President, 1971, 25 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: 35 cents.)

Reviews the historical background of the proposals, describes the need for executive reorganization, and outlines the basic rationale for reorganization; the President has proposed the creation of 4 new departments (Natural Resources, Human Resources, Economic Affairs, and Community Development) to replace the existing Departments of Agriculture; Commerce; Health, Education, and Welfare; Housing and Urban Development; Interior; Labor; and Transportation; describes the responsibilities of the new departments in such areas as energy, water resources, atmospheric sciences, health, agricultural administration, transportation, and urban administration.

3172. Lewis, H. J., "On Budgetary Axes and Damocletian Swords", *sppsg Newsletter*, v. 3, no. 9, November 1972, pp. 1-4.

Discusses the limitations on spending likely to be imposed by the Nixon Administration in 1973, and examines the implications for the national research community which is doubly vulnerable because: (1) almost all of the U.S. scientific research is funded from the "discretionary" portion of the budget (estimated at $55 billion in FY'73) from which all cuts (estimated at $20 billion annually) must come; and (2) most cuts may be in expenditures, rather than appropriations, and thus constitute a Government refusal to honor obligations undertaken by its contractors and grantees; describes the Government's trend toward support of research producing visible benefits to the economy and the quality of life, and a policy decision with OMB to partially decouple research support from support of academic institutions.

3173. "Defense Research Hit Hard by Congress", *Science & Government Report*, v. 2, no. 16, 15 November 1972, p. 6.

Discusses the reasons for the sharp cut in Congress's appropriations for military sciences (by more than $60 million): (1) complaints that DOD made little effort to avoid duplication of work in contracts with academic institutions and industry, or in its own laboratories, and (2) the belief that expansion of research funding by

other agencies and the private sector lessened the need for Government support of basic science; notes the view of the deputy director of the Office of Science and Technology that the defense research reduction is a serious loss which no other agency is immediately prepared to take up; presents a table showing Federal R&D obligations for all agencies, which reflect an overall increase of some 7% from 1972.

3174. Magruder, W. M., "Technology, National Goals, Aerospace, and Our Society", *Congressional Record*, v. 118, no. 165, 13 October 1972, pp. S17886-17889.

Outlines activities initiated by the Nixon Administration which will directly affect health of the aerospace industry (e.g., Phases I and II Economic Policies, international agreements on monetary exchange rates and social programs, environmental controls, etc., and revenue sharing); describes Government efforts to promote technological change by stimulating innovation and productivity through programs like the Technology Opportunities Program; discusses the economic justifications for Government investment in urban R&D, and reviews technological trends since the close of World War II, stressing the present trend toward civilian R&D.

3175. "NTIS Offers New Service – Instant Retrieval of 300,000 Government Reports", *U.S. Department of Commerce News*, 15 November 1972, 2 pp.

Announces that the National Technical Information Service has inaugurated an advanced information retrieval service (NITSearch) to provide immediate access to more than 300,000 government technical reports; the service will be available to the public on a fee basis, and will help users review Government-funded R&D reports collected since 1964.

3176. "Minerals Research: Mining Schools Finally Hit Pay Dirt", *Science & Government Report*, v. 2, no. 15, 1 November 1972, pp. 7-8.

Announces the approval by Congress of an amendment to the Mining and Minerals Policy Act of 1970 – which authorizes appropriations to the Interior Department of $25.2 million in FY 1973: (1) to assist in establishing research institutes at tax supported schools; and (2) to support a broad range of R&D projects that will be conducted by academic, industrial, private, and governmental investigators; outlines the kinds of Federal funding authorized (which could amount to $40 million within 5 years), and observes that, although some uncertainties lie ahead, it appears likely that the legislation "signals a quantum leap" in the importance of the Interior Department's Bureau of Mines as a supporter of outside research.

HEALTH AND SAFETY

3177. "Remote Health Care Site to be Selected", *Machine Design*, v. 44, no. 30, 14 December 1972, p. 18.

Announces NASA's plans for field testing a remote-health-care system for long-duration space flights; describes the elements of the system and outlines the major considerations in selecting a test site: (1) complete cooperation of the community, both citizen-patient and the medical profession, to use the system and work with the medical personnel operating the equipment; (2) minimum population of 10,000; (3) availability of medical and technical personnel; (4) willingness of the community to support cost of operating feasible elements of the system after the initial 2-year period; and (5) temperate climate to minimize requirements for unique heating or cooling facilities; the test, if successful, will also provide information and techniques for improving medical services in remote areas on earth.

3178. "Centre for Sussex", *Nature*, v. 240, no. 5380, 8 December 1972, p. 316.

Describes plans for establishing an autonomous interdisciplinary medical research centre with its own building at the University of Sussex; research activities will involve the biological sciences, biomedical engineering, behavioural and socio-environmental aspects of patient care, psychosomatic factors in diseases, as well as medical ethics and law.

3179. Kenward, M., "Numbers in Safety", *New Scientist*, v. 56, no. 824, 14 December 1972, p. 620.

Refers to two recent reports from the Science Policy Research Unit at Sussex University which propose a methodology of cost-effectiveness determination that aims at guiding the government and industry to where they should spend money on human safety; the value of the life of workers in different industries varies widely, if money spent on safety is a criterion; notes that cost-effectiveness is a better guide to where safety money should go "than the irrational approach of responding to disasters by spending insane amounts of money to ensure that they never happen again, while obvious risks that can be readily reduced are ignored".

HUNGARY

3180. "Hungary: Research Programme for 1971-85", *Science Policy*, v. 1, no. 5, September/October 1972, p. 3.5.

Summarizes the research to be conducted in the fields of study responsible to the Secretary-General of the Hungarian Academy of Sciences, as specified by the Hungarian Cabinet; the fields of study so specified are: the study of solids, processes in living organisms, development of administration, and the socialist enterprise; also summarizes research in the fields of biologically active compounds (responsible to the Minister of Heavy Industry), and optimum macro- and micro-environment for man (responsible to the Minister for Construction and Town Planning).

INDIA

3181. "India Will Develop Own Satcom", *Aviation Week & Space Technology*, v. 97, no. 24, 11 December 1972, p. 20.

Announces that the Indian space research organization is aiming for a 1982 launch date for a communications satellite which it will develop itself and place in orbit with its own launch vehicle; the goal of this major national space effort is to establish a communications network to reach a greater portion of the Indian population, 80% of which is now incommunicado.

INTERNATIONAL SCIENCE ACTIVITIES

3182. Brown, L. R., "New Supranational Institutions", *The Futurist*, v. 6, no. 5, October 1972, pp. 197-202.

Discusses the needs for establishing supranational institutions to deal with those problems in fields ranging from nuclear weapons to weather modification which have become too large for any one nation to deal with properly; describes possible formats for international institutions governing the exploitation of ocean resources, for dealing with the world's environment, for regulating the interface between global corporations and nation-states, for supranational research institutes, and for a United Nations Disaster Relief Force; suggests actions to improve the effectiveness of the U.N.

3183. "At OECD: Meeting of the Committee for Scientific and Technology Policy", *OECD Observer*, no. 60, October 1962, pp. 40-41.

Outlines the work programs developed by the OECD's Committee for Scientific and Technological Policy, including: (1) statistical work on R&D; (2) R&D in the service sector; (3) development and utilization of social sciences; (4) completion of studies on the "research system"; (5) organization of information, computer, and communications systems; (6) stimulation of innovation in private and public sectors; (7) management and control of technology (involving technology assessment); (8) international cooperation in R&D; and (9) science and technology for developing countries; presents the agenda of the Committee's meeting (held at OECD headquarters, 12-13 July 1972); the main item for discussion was the program of work for 1973, and the Committee decided to set up guidance and coordinating groups to further the work of programs (1) and (5) above; high priority was also accorded to the international exchange of research workers.

3184. Huntley, J. R., *Man's Environment and the Atlantic Alliance*, 2nd Edition, October

1972, 62 pp. (Available from U.S. Department of State, Washington, D.C. 20520.)

The first edition of the booklet [published in June 1971 and reviewed in *SPR* 4(4):1470] has been updated to include the 1972 activities and agreements; includes 3 Challenges of Modern Society as well as new developments and agreements; includes 3 appendixes presenting a CCMS Chronology (1969-1972), a listing of NATO/CCMS publications, and the U.S./Federal Republic of Germany Bilateral Agreement on the Experimental Safety Vehicle.

3185. *Public Affairs in the United States and Europe*, Report on the international Conference on Public Affairs, Lausanne-Ouchy, Switzerland, 16-17 March 1971, 79 pp. (Available from The Conference Board, Inc., 845 Third Ave., New York, N.Y. 10022. Price: $17.50.)

Reports on the 2-day Conference on Public Affairs which was designated to promote the exchange of views between European and American business leaders on methods of dealing with social problems affecting their countries; the format called for presentation each morning by American businessmen describing company policy, practices, and experiences in the areas of urban, environmental, educational, and governmental affairs with responses each afternoon by the Europeans; 4 issues were identified as being of overriding importance – problems related to pollution control, educational needs, urban decay, and government-business communications – and participants' views on these are summarized.

3186. "Accord with Poland", *Nature*, v. 240, no. 5386, 10 November 1972, pp. 67-68; also in *U.S. Department of State Bulletin*, v. 67, no. 1744, 27 November 1972, p. 642.

Announces the signing of a broad agreement on cooperation in science and technology by the governments of the U.S. and Poland; although the agreement lacks a commitment from either government to spend money or undertake specific programs, it broadens the scope of the present cooperation between the countries, elevating it from the level of "ad hoc" arrangements between institutions to a formal agreement, specifically the agreement provides for such activities as joint R&D projects between institutions in the two countries and the sharing of results and data from scientific studies.

3187. *Memorandum of Understanding of the Joint Soviet-American Conference on the Problem of Leukemia and Tumor Viruses of Animals and Man (Moscow, 17-18 November 1972)*, U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health, Bethesda, Md. 20014, 1972, 9 pp.

Sets forth the main areas of cooperation in cancer research agreed to by the two countries, as well as instruments of cooperation which include the exchange of health professionals, of research reagents and scientific specimens, and of scientific information; additionally, both delegations agreed upon the necessity of establishing a U.S.-U.S.S.R. Subcommittee on Cancer Virology.

3188. Craddock, C. (Comp.), *Earth Science Investigations in the United States Antarctic Research Program (USARP) for the Period 1 July 1971 – 30 June 1972*, National Academy of Sciences, National Research Council, 1972, 44 pp. (Available from Committee on Polar Research, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C. 20418.)

Presents summaries of U.S. work along with those of reports prepared by other nations, as a service to Antarctic researchers throughout the world to help them keep informed about the activities and publications of their colleagues; the information was obtained through a questionnaire survey; foreign nations represented include Australia, Norway, Sweden and Switzerland; earth science activities reported include geological, geophysical, geochemical, biological, and oceanographic studies, geological mapping, and operation and maintenance of the Geodetic Satellite Observatory at McMurdo.

IRELAND

3189. Cahill, F. B., *Marine Resource Development*, Report to the National Science Council, 1972. (Available from National Science Council, Dublin, Ireland. Price: 50 p.)

Presents a consensus of experts in the various marine fields concerning the development of Ireland's marine resources: (1) lack of coordination is inhibiting

the development of resources; (2) lack of basic data is preventing urgently needed planning and forecasting; (3) fishing, transport, and hydrocarbons are identified as the areas of greatest potential; urges the establishment of a "Marine Development Board", the function and constitution of which would be the subject of Government decision, and suggests that statutory authority would contribute to its effectiveness.

ISRAEL

3190. "United States and Israel Establish Binational Science Foundation", *U.S. Department of State Bulletin*, v. 67, no. 1739, 23 October 1972, pp. 485-486.

Reports major provisions of an agreement establishing the U.S.-Israeli Binational Science Foundation, designed "to promote and support cooperation between the U.S. and Israel in research in science and technology for peaceful purposes on subjects of mutual interest"; the agreement calls for each nation to provide the equivalent of $30 million in Israeli pounds for the Foundation's endowment; a 10-member Board of Governors (5 appointed by each country) will determine the areas for cooperative research, the research programs, and the Foundation's financial and managerial policies.

JAPAN

3191. Nakasone, Y., "The Way Ahead for Japanese Science Policy", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 187-188.

Japan's Minister of State for Science and Technology claims that Japan should restore the balance between the neglected biological sciences and the favored physical sciences and engineering; indicates that Japan hopes to place special emphasis on the promotion of the life sciences as a national project, while strengthening research efforts in other fields; contends that the "soft" sciences (the science of controlling science and technology) will have to be encouraged more strongly in the future; notes that the Japanese Science and Technology Agency (STA) is preoccupied with technology assessment methodology development; reviews the roles of the STA in formulating and coordinating national science and technology policy and in promoting "big science" in Japan.

3192. Ochi, Y., "The Organization and Activities of the Science Council of Japan", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 188-191.

Dr. Ochi, president of the Science Council of Japan, traces the history, organization, functions, and activities of the 210-member Council beginning just after World War II when it was founded as "the representative body of the scientists of Japan both in and out of the country"; refers particularly to its contributions on problems of radiation effects, atomic energy, and problems facing science and technology in and after the 1970's; reviews long-term planning by the JSC, including recommendations for the establishment of numerous specific new institutions for the basic sciences.

3193. "Can R&D Spending Improve Exports' Sales?", *Inside R&D*, v. 1, no. 29, 18 October 1972, p. 2.

Reports major findings of a Japanese study (covering Japan's 16 major industries) which indicates that large R&D outlays are one of that country's keys to large export sales; the findings include: (1) the 5 industrial groups who spent the most on R&D as percent of sales (i.e., chemicals, electrical, precision machinery, rubber products, and transportation machinery) were the most successful in selling their products; (2) on the average, these groups spent 2.4% of each sales dollar on R&D, while all 16 groups spent only 1.22%; Japanese analysts conclude that there is a direct relationship between R&D spending and international competitiveness.

3194. Katsunuma, H., "Unrest in the Japanese Universities", *Nature*, v. 240, no. 4378, 24 November 1972, pp. 193-194.

Summarizes the causes and results of the recent student troubles at Tokyo University; points to the stresses in university administration resulting from rapid, revolutionary developments in the physical, biological, political, social, and infor-

mation sciences; credits student uprisings with effecting reforms, increased student participation, increased curriculum flexibility, more appropriations for teaching and research, greater emphasis on international relations, and greater awareness of social needs.

3195. Shima, H., "Japan in Space", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 215-217.

Dr. Shima, president of Japan's National Space Development Agency, outlines past and future development of Japan's space research which has taken place exclusively at Tokyo University, beginning in 1955; describes the types, missions, and orbits of the 4 satellites which Japan now has in orbit; discusses the importing of U.S. space techniques into Japan and the future of U.S.-Japan launch collaboration.

3196. "Japan Strives for Satcom Launch in Mid-70s", *Aviation Week & Space Technology*, v. 97, no. 24, 11 December 1972, p. 19.

Announces that the Japanese space industry is striving to establish an independent satellite launching capability that would allow the country to launch its first communications satellites by 1975 or 1976; describes a 3-stage launch vehicle currently under development that would provide a capability to put practical, working satellites such as satcoms into geosynchronous orbit.

3197. Hidaka, K., "Oceanography in Japan", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 207-209.

Prof. Hidaka traces the history of the development of oceanography in Japan from its inception a century ago to the present; describes early Japanese hydrographic studies, Antarctic expeditions, research vessel activities, and the oceanographic work of a number of Japanese investigators before and after World War II; includes a discussion of the Ocean Research Institute at the University of Tokyo, as well as the oceanographic work at a number of Japanese universities.

3198. "The National Research Centre for Disaster Prevention", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 200-201.

Presents the 4 main purposes of Japan's National Research Centre for Disaster Prevention (NRCDP): (1) promotion and coordination of disaster-prevention research involving several government agencies; (2) establishment and management of a large-scale instrument for research relating to disaster prevention; (3) development of basic, universal studies on the prevention of disasters; and (4) collection and collation of information relating to disaster prevention; describes the Centre's activities in pursuing these objectives, such as earthquake research, weather-control experiments, and forecasting of floods and droughts by means of computer simulation.

3199. "Problems of Selling Technology to China", *Inside R&D*, v. 1, no. 30, 25 October 1972, p. 2.

Reports that Japanese experts returning from China see problems in selling technology to that nation because: (1) the Chinese show a strong desire for self-help; (2) they are likely, once they get hold of a certain technology, to study it and develop spin-off techniques; (3) the idea of paying for technology is foreign to the Chinese way of thinking; and (4) China has no system for protecting industrial properties; describes an aggressive program initiated by the Japanese to sell technology to China, in spite of the problems, and notes that no technology will move to China until Chinese and Japanese work out details of how firms will be compensated.

LAND USE

3200. *Urban Growth and Land Development: The Land Conversion Process*, Report of the Land Use Subcommittee, National Academy of Sciences – National Academy of Engineering Advisory Committee to the Department of Housing and Development, 1972, 53 pp. (Available from Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Ave., Washington, D.C. 20418.)

Reviews past unsuccessful efforts to define a national urban growth and land

development policy, suggesting a key reason for this lack of success – failure to develop a realistic set of assumptions concerning population growth, distribution, and land consumption; comments on past assumptions, and briefly states the consensus of the Subcommittee concerning a realistic set of assumptions for present and future policy makers; presents general analysis of the land conversion process, and its impact on select urban growth issues (on land prices, housing costs, etc.); suggests criteria for allocation of Federal funds for urban growth and land conversion purposes, initiation by the Federal Government of selected demonstration projects, and further research needed.

MANAGEMENT OF SCIENCE

3201. *Management of Research and Development*, Papers presented at a Seminar Organised by the Scientific and Technical Research Council of Turkey, Istanbul, Turkey, 4-8 May 1970, 329 pp. (Available from OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. Price: $5.75.)

Presents 12 papers dealing with such topics as: technological advance as a factor in Turkish development planning, resource allocation for R&D in the U.S., national R&D policy as a social innovation, promoting the "D" in R&D, forecasting and planning as they relate to policy sciences, new problems in science policy, the aspects of science development, the implications of theoretical studies for decision making in R&D management, industrial innovation and science policy in less-developed countries.

3202. Mencher, A. (Ed.), *Management and Technology: Vol. I – An Anglo-American Exchange of Views*, Science Policy Foundation Special Publication Series, 1972, Inforlink, Ltd., 2 A Station Road, Frimley, Surry, England, September 1972. (£4.05)

Presents 8 papers by eminent men in the world of science, management, and business in the U.S.: 1. Some Hypotheses on the Management of Research and Development, 2. The Evaluation of Management Systems, 3. Impact of Accelerating Technological Advance on Business and Industry, 4. Management and Sociology of Innovation, 5. Venture Capital Activities and the Large Corporation, 6. Technology and Business, 7. The Confusing Computer, and 8. Successful Technical Innovations; the book is based on discourse/discussion meetings held at the American Embassy, London, during 1969-71 and attended by British business, management, and research executives as well as academics from industry, business, government, and the universities, and includes discussions reflecting current British opinion.

3203. Gaston, J., "Social Processes in Science", *New Scientist*, v. 56, no. 823, 7 December 1972, pp. 581-583.

Discusses the role of the social processes of competition, cooperation, discrimination, and cooptation in interactions between individual scientists and groups of scientists; cites examples of discrimination (Nazi Germany and women in science) and cooptation (hiring promising proteges as assistants); dwells on different aspects of competition in science (stimulation, wastefulness, national differences, variations among research specialties, and variations in responses by different scientists); notes that competition and cooperation among scientists or groups are not mutually exclusive, and that cooperation is probably the more prevalent of the two.

3204. Laserson, G. L., and Sperling, J., *The Survival of R&D in American Industry*, An AMA Research Report, 1972, 32 pp. (Available from American Management Association, 135 W. 50th St., New York, N.Y. 10020. Price: $7.50.)

Presents findings from 242 questionnaire replies indicating that the biggest problems faced by R&D managers are motivating people, instilling a sense of urgency, and keeping morale and output high; suggested solution: educate non-R&D people to benefits of R&D and improve self-image of R&D staff; respondents noted lack of understanding of R&D by top management, and suggested continuing education; conclusions were (1) R&D is going through a traumatic period but surviving, (2) industrial R&D is not adequately organized and planned, (3) the recent economic pinch may benefit R&D in the long run, (4) the impact of "social" needs on R&D is growing in importance, requiring new mechanisms for planning,

funding, and executing R&D.

3205. "NSF Predicts Rise in Industrial R&D", *R&D Management Digest*, v. 2, no. 6, December 1972, p. 1.

Presents projections on industrial R&D which are based on a National Science Foundation Survey of top R&D officials in 50 corporations; NSF predicts that (1) company-funded R&D will increase by ~25% between 1972 and 1975 to ~$14 billion annually; (2) the number of scientists and engineers employed in company R&D programs is expected to increase from 240,000 in 1972 to 260,000 by 1975; (3) industry expenditures for basic research are also expected to increase (from $480 million in 1972 to $600 million by 1975).

3206. "Myths About Industrial Research", *Inside R&D*, v. 1, no. 35, 29 November 1972, p. 4.

Outlines 5 myths identified at a meeting of chemical manufacturers (in New York) by E. B. Barnes, president of Dow Chemical USA, in urging more industrial research: (1) day of big inventions is past; (2) research cannot be managed to produce results; (3) research should be isolated from all other functions in the company; (4) research is service bureau; (5) you can turn research on and off like a faucet; at the same meeting, Presidential Science Advisor, E. E. David, stated that the Administration was not convinced that tax incentives for R&D would lead to increased industrial R&D effort.

3207. *Industrial Research Institutes: Guidelines for Evaluation*, United Nations Industrial Development Organization, 1971, 81 pp. (Available from Industrial Institutions Section, UNIDO, P.O. Box 707, A-1011 Vienna, Austria. Price: $2.00.)

Outlines procedures for assessing the effectiveness of industrial research institutes through both quantitative and qualitative approaches; Chapters 1-5 are concerned with criteria for which quantitative information can be collected, and cover financial position, work carried out, development of technical capabilities, and provision of facilities; Chapters 6-9 deal with subjects that can be evaluated subjectively (i.e., general administration, selection of program areas, administration of technical activities and personnel administration), but a methodology is proposed that will assist in making the ratings more meaningful; Chapter 10 proposes a comprehensive technique for the overall rating of management and the performance of an industrial research institute.

3208. "New-Type Professional to Guide Industry Growth", *Machine Design*, v. 44, no. 27, 16 November 1972, p. 4.

Discusses the need for specialists trained in a variety of disciplines (from engineering to sociology) in order to become "broadly expert at managing the application of science to society", as set forth by Dr. S. Ramo, vice-chairman of the board of TRW, Inc.; Dr. Ramo predicts a new peak in business and industrial growth, along with a growing demand for scientists, engineers, business administrators and other university-trained personnel, but stresses that industry will need "the interdisciplinary man" to solve the interconnected, interface problems of today (e.g., urban rapid transit, improved medical care, the building of efficient cities, and pollution control).

3209. Roy, R., "University-Industry Interaction Patterns", *Science*, v. 178, no. 4064, 1 December 1972, pp. 955-960.

Stresses the need for greater efficiency in the U.S. R&D system to increase the R&D output without major increases in resource allocation, and identifies one of the most wasteful aspects of the system, viz., the weak coupling between the university and industry (or government); describes the types of universities wherein research requiring coupling could best be conducted; outlines criteria for successfully translating university-industry research into products, developed by those involved in one successful coupling effort: (1) demonstrated scientific experience, capability, and competence, plus a novel approach or idea; (2) demonstrated performance of the university sector in industry-related research; (3) proximity or ease of communication between the units involved; (4) industry employees working in the university at least part time; and (5) strong university management.

3210. Clark, R. D., "Can the Chemical Industry Afford Research?", *Chemical Technology*, v. 2, no. 11, November 1972, pp. 656-659.

Contends that "the chemical industry has outgrown its need for research", and illustrates by tracing the decreasing benefits of internal R&D to a small modern chemical company as it grows into a large corporation; shows that the latter can license technology cheaper than it can develop it, and that the typical large corporation is not even organized to take advantage of research.

MANPOWER – TECHNICAL AND SCIENTIFIC

3211. Falk, C. E., "R&D Manpower for the Future: 1. A Comparison of Various Projections", *Research Management*, v. 15, no. 5, September 1972, pp. 13-23.

An abstract of this article in the last issue [*SPR* 5(3):2798] points out that it identifies the principal variables that will affect future employment opportunities for scientists and engineers and predicts no significant improvement in the short-range supply/demand picture; the abstract then states that projections indicate a serious shortage of scientists and engineers by 1980 – a statement which the author objected to as "almost directly contrary to the views of the article"; *SPR* stands corrected; the article does indeed indicate an average potential *oversupply* up to 13% (or at best an equilibrium) of science and engineering doctorates by 1980, with possible shortages of non-Ph.D. chemists, physicists, engineers, and earth scientists.

3212. "Manpower Issues in the Professions and Higher Education", A Reprint from *The 1972 Manpower Report of the President*, 1972, pp. 103-138. (Available from U.S. Department of Labor, Manpower Administration, Washington, D.C. 20210.)

Describes the reasons for the changed job market for professional personnel and the decreased demand for college and university faculty members (e.g., Government cutbacks in expenditures for the defense and space programs and for R&D activities, and increased supply of professional and technical workers); notes the increasing demand for health workers, and examines the outlook for renewed growth in overall professional employment, which is expected to be pretty good in the long term, except for Ph.D.'s, where the supply is expected to exceed demand; discusses the recent unemployment problems of scientists and engineers, and the expected renewed growth in scientific and engineering employment because of the crucial role of these professions in the scientific and technological progress essential to the U.S.'s economic well-being, the solution of its domestic problems, and to the national defense. (The full *Manpower Report of the President* is available from the U.S. Government Printing Office, Washington, D.C. 20402. Price: $2.25.)

3213. Price, D., de S., "Boom Ahead in Technical Employment", *Science & Government Report*, v. 2, no. 16, 15 November 1972, pp. 4-5.

Describes the fluctuations over the past several years in the Engineer/Scientist Demand Index, produced by Deutsch, Shea & Evans, which at present indicates a sharp upsurge in scientific and technical employment in the next 2 years; discusses the policy implications of the fluctuations in the Index, warning that the boom in employment is likely to be followed by a highly destructive bust unless policy makers find an "antidote"; and suggests that "what the health of both the science and the engineering sectors of R&D employment need for a policy is forces that will let the index recover to a reasonable level and then insulate it more effectively from the sudden change of signal".

3214. "Present and Future Job Prospects of Engineering and Technology Graduates", *Engineering Manpower Bulletin*, no. 23, October 1972, pp. 1-4.

Presents highlights of the placement status of the 1972 graduates, citing statistics which indicate that despite the recent slowdown in hiring, there was no general shortage of jobs for graduates from engineering and technological programs at any level and that starting salaries of engineers were higher than those of practically all other new graduate groups; includes a summary of the views of placement directors concerning future job prospects, obtained through a questionnaire, the majority of whom expected continuing improvement and excellent prospects for 1973 (with civil and mechanical engineering offering the best opportunities among the larger curricula) and predicted outstanding prospects for 4-5 years hence.

3215. "Demand for Engineers Continues to Climb", *Machine Design*, v. 44, no. 26, 2 November 1972, p. 4.

Announces that the demand for technical manpower continued to move upward in July, with the Engineer/Scientist Demand Index (maintained by Deutsch, Shea & Evans, New York recruitment advertising specialists) registering 80.7, up 13.5 from June; technical recruitment activity in the West was markedly higher, while that in the Midwest remained stable; gains in aerospace were noted for the first time in many months, and improvement in electronics was also noted.

3216. "Federal Programs Aid the Jobless", *Chemical & Engineering News*, v. 50, no. 40, 2 October 1972, pp. 21-22.

Describes deficiencies in current Governmental programs designed to aid unemployed scientists and engineers and the debate as to the extent of their success; presents a brief rundown of the programs, including the Technology Mobilization and Reemployment Program, the Volunteer Engineers, Scientists, and Technicians program, and the National Science Foundation's retraining program.

3217. "Former Aerospace/Defense Engineers Make Career Transition through Courses and On-the-Job Training", *Mechanical Engineering*, v. 94, no. 11, November 1972, p. 73.

Describes the success of Technology Utilization Project (TUP), a nationwide program being run by the National Society of Professional Engineers with funds from the U.S. Department of Labor; suggests that this success is partially due to a unique feature of the program, viz., prior job commitments by prospective employers before the engineers begin academic training; points out that even the intense level of academic training given will not make these engineers immediate experts in the new field, but will prepare them for on-the-job training; particularly successful are 2 of the more advanced TUP programs – forestry and safety engineering.

3218. Nichols, R., *Women in Science and Engineering: Are Jobs Really Sexless?* Preprint of paper (No. 72-WA/TS-2) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 16 pp. (Available from ASME, United Engineering Center, 345 East 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Reveals that, despite laws providing equal opportunities for women, discrimination still exists both in position and pay; cites statistics which show that women are more disadvantaged occupationally than they were 30 years ago, e.g., in 1940 women held 45% of the professional and technical positions, whereas in 1969 the percentage was only 37%; points out that enrollment of women in the fields of science, and engineering in particular, is still limited, and suggests such things as better guidance and encouragement of females with scientific aptitude, at the high school level, are urgently needed to get more women involved in engineering and science and other traditionally male occupations.

3219. "R&D Still Minor Source of Company Chief Execs", *Industrial Research*, v. 14, no. 11, October 1972, p. 24.

Presents the key findings of a study of the backgrounds of presidents of corporations who took office or remained in office from 1968 to early 1972 which indicate that marketing and financial men both finished in a tie as the first choice for presidency, production men took third place, and R&D people, along with chemist executives, finished next to last (all differing from past trends); discusses the reasons for the changes in the kinds of presidents companies select, such as most companies' emphasis on marketing more competitively and operating more productively.

3220. "Plight of Soviet Scientists Draws Concern", *Chemical & Engineering News*, v. 50, no. 50, 11 December 1972, pp. 12-13.

Reviews the actions of non-Soviet scientists, especially those in the U.S., in protest against the lack of freedom of Soviet scientists, particularly the Soviet Jewish scientists who are also harassed when they attempt to emigrate to Israel; observes that most of actions are on a private, nonorganization basis, and only 3 U.S. scientific organizations have taken an official stand on the U.S.S.R.'s policy.

METRICATION

3221. DeSimone, D. V., "A Metric America: A Decision for the Engineering Community and for the Nation", *Mechanical Engineering*, v. 94, no. 11, November 1972, pp. 35-40.

Describes the approach used in a 3-year metric study and the measurement systems considered; cites examples of the increasing use of the metric system in the U.S., and outlines the consensus on "going metric": (1) increased use of the metric system is in the best interests of the U.S.; (2) the nation should change to the metric system through a coordinated national program; and (3) the transition period should be 10 years; stresses the urgency of more vigorous participation by the U.S. in world standards-making, citing legislation already introduced (HR 8111) as a significant step in this direction; the metric study report recommends a coordinated changeover program "that provides for flexibility and encourages the various sectors of society to deal with their particular problems voluntarily, efficiently, and at a minimum cost".

3222. "Metric System Study Passes Senate", *BioScience*, v. 22, no. 10, October 1972, pp. 612-613.

Describes Senate Bill S. 2483 authorizing a study of the metric system to be made by an 11-member National Metric Conversion Board with a mandate to formulate within 18 months a comprehensive national conversion plan, which would make the metric system the predominant but not exclusive system of weights and measures in the U.S.; outlines the background and committee and floor actions concerning the bill.

NATIONAL SECURITY

3223. Marsh, R. T., "National Security", *Astronautics & Aeronautics*, v. 10, no. 12, December 1972, pp. 32-34.

Outlines the topics that will be discussed at the AIAA's 9th Annual Meeting in special sessions on national security, including authoritative discussions of coming strategic systems, salient methods of weapons development and their economic implications, new design avenues to meet standing requirements, and the value of military R&D to the public's everyday needs and activities.

3224. Fineberg, R., "United States Continues Work on CBW", *New Scientist*, v. 56, no. 822, 30 November 1972, p. 501.

Reports that research in the U.S. on lethal chemical weapons has nearly doubled in the 3 years since President Nixon disavowed first use of such weapons, mainly directed toward perfecting a new method of delivering nerve gas, called the binary system; describes U.S. foot-dragging on the implementation of international CBW laws while it continues what the Army calls "defensive" CBW research.

3225. "Chemical/Biological Warfare", *Congressional Record*, v. 118, no. 163, 11 October 1972, pp. S17478-17482.

Reprints 2 articles by R. A. Fineberg and by D. S. Greenberg, which serve as the basis for an informed critique of the CBW program; the authors underscore the Nixon Administration's contradictory stance: namely, its announced support of international agreements to ban the use and stockpiling of chemical and biological materials, while continuing the U.S. CBW program on a large scale, and present facts to back up their claims that the program is still flourishing.

NETHERLANDS

3226. "Scientific Council for Government Policy", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.4.

Describes the organization and purpose of the Netherland's Science Council as spelled out in the Framework and Terms of Reference of the Council: the Council is to operate as an independent advisory body on new developments in society, responsible to the Prime Minister, and its purpose is: (1) to identify and draw attention to bottlenecks in long-term development; (2) to define the nature of major long-term policy problems; and (3) to indicate policy alternatives; with

respect to studies in the sphere of research on future development and long-term planning in both the public and private sectors, the Framework calls for the Council, within its own province, to advise the Government on: (1) the elimination of structural inadequacies and the furtherance of specific studies, and (2) the improvement of communications and coordination.

NORWAY

3227. "Norwegian Research Organization", *R&D Management Digest*, v. 2, no. 5, November 1972, p. 11.

Identifies Norway's principal research councils, pointing out that their activity is organizational, consultative, and financial, and they perform no research work; two of these councils include representatives of government, research institutes, business, and industry, while the other comprises members from government and research institutes only; expenditures for R&D in Norwegian universities, research institutes, and similar institutions amount to more than $100 million annually, and of the total expenditures for operating purposes in R&D in 1969, 25% was spent for basic research, 31% for applied research, and 44% for development.

OCEAN – INTERNATIONAL ACTIVITIES

3228. "A New Law for the High Seas", *Technology Review*, v. 75, no. 1, October/November 1972, p. 64.

Describes the need for control of activity in and on the open seas, and outlines a proposal for an international authority to provide that control, advanced by Arvid Pardo, Malta's Minister for Ocean Affairs at the U.N.; the Authority would be concerned with " 'the credible maintenance of law and order' on the oceans, the safeguarding of the natural state and quality of the marine environment, the promotion of research and the dissemination of scientific knowledge, the development of technology for the penetration and use of the oceans, the coordination of the uses of the oceans by different nations and the orderly management of ocean space beyond national jurisdictions"; the authority would have complete powers to license vessels for research, fishing, mining, etc., and could, in case of disobedience, revoke a nation's license.

3229. "Agreement Reached on Dumping at Sea", *Nature*, v. 240, no. 5377, 17 November 1972, p. 120.

Announces agreement on an international convention to prevent the dumping of persistent and toxic wastes and ties the dumping of less toxic wastes to a permit system; the convention covers all intentional dumping, not the disposal of waste from vessels or aircraft if such disposal is derived from normal operations, waste arising from off-shore exploration and exploitation of mineral resources, or any military machines; meetings are planned for 1973 to discuss the operation and policing of the pact, which will come into force when 15 countries have ratified it.

3230. *Identification and Control of Pollutants of Broad International Significance: Addendum No. 1: Draft Articles of a Convention on Ocean Dumping*, submitted to the United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16 June 1972, 16 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22150. Price: $3.00.]

Presents the text of 21 draft articles produced by the Intergovernmental Meeting on Ocean Dumping, held at Reykjavik, Iceland, 10-15 April 1972, and attended by representatives of 29 States; in general, under these articles, each Party to the Convention pledges (a) to take effective measures individually and collectively to prevent pollution of the sea by the dumping of harmful or hazardous substances; (b) to prohibit dumping of any matter in the sea except as the Convention will allow; (c) to designate an appropriate national authority to issue the special permits for dumping required by the Convention; (d) to apply the measures required to implement the Convention to all vessels and aircraft registered or loading in its territory, or under its jurisdiction (as in the case of fixed or floating platforms) within the confines of international law; and (e) to promote measures to protect the marine environment against pollution; includes 3 annexes listing the

substances considered harmful, and outlining the provisions to be considered in establishing the criteria for the issuance of permits for ocean dumping.

OCEAN – U.S. ACTIVITIES

3231. Wenk, E., Jr., *The Politics of the Ocean*, University of Washington Press, Seattle, Washington, 1972, 590 pp. ($14.95)

Offers perspectives on recent policy development in ocean affairs . . with a blend of scientific, technological, economic, legal, social, and political factors involved in the ocean-man interaction; presents anecdotal studies in selected cases of coastal use management, multinational ocean exploration, evolving law of the sea, and marine resource development; assesses the capacity of modern government to deal with the problems and issues arising from interactions of science and technology with our society and its institutions, offers proposals to improve the governmental decision-making process relating to science and technology, and outlines a new management-oriented role for the U.S. Vice-President.

3232. Noone, J. A., "New Federal Program Seeks to Aid States in Control of Coastal-Area Exploitation", *National Journal*, v. 4, no. 5, 9 December 1972, pp. 1889-1898.

Traces the progress of the Coastal Zone Management Act of 1972 through the Congress, from time of its introduction to the time when it became a law; outlines the next steps in the national coastal planning program: (1) preparation of guidelines by the National Oceanic and Atmospheric Association; (2) application by the 30 coastal states for planning grants; and (3) actual implementation by the states, with some of the responsibility falling to local governments; presents a summary of current coastal-zone activity and pertinent state laws in the 30 coastal states.

3233. Glover, J. R., "Comments Concerning the Coastal Zone of the United States", *Congressional Record*, v. 118, no. 172, 8 November 1972, pp. E9258-9259.

Representative Glover stresses the importance of the Coastal Zone Management Act of 1972, and describes the efforts of New York State's Nassau and Suffolk Counties to develop a coastal-zone management program; reprints the text of an address by J.V.N. Klein, county executive of Suffolk County, which discusses the key issues confronting all coastal states in their quest for sound management of the coastal zone, including the need for science/technology information transfer to management, to provide clear and unmistakable information needed for sound management decisions.

PHILIPPINES

3234. Orillo, F. T., "Produce More Through Research and Development", *Philippine Science Review*, v. 11, no. 5, September-October 1971, pp. 20-22.

Discusses how the Philippines can increase agricultural productivity through research and development; cites reasoning behind the following 4 suggestions for accomplishing this: (1) research activities should be more optimally coordinated and integrated, (2) public research institutions should support or sustain researchers more adequately, (3) research should be more clearly anchored on national development needs, (4) research results should filter down to the grass-roots level.

3235. Santillan, F. L., "Let Us Help Develop Research and Invention", *Philippine Science Review*, v. 11, no. 5, September-October 1971, pp. 12-16.

Reviews the goals and values of scientific research and technological invention, and quotes David Lilienthal that "the purpose of research then, largely determines whether it is likely to further human well-being, or threaten to destroy it"; presents an overview of the nature, scope, and values of research and invention in community development and service, citing as examples the philosophy and practices *vis-à-vis* R&D in the Philippines (desire to devote more of GNP to science, Science Act of 1958, and the programs and projects of the National Institute of Science and Technology and the Philippine Inventor's Commission).

3236. Cortes, J. R., "Research in Science Teaching in the Philippines", *Philippine Science*

Review, v. 13, no. 1, January-February 1972, pp. 41-44.

Discusses research activities in science teaching that are directed toward ascertaining how and in what concrete ways science and math education contribute to national advancement; poses specific issues in this regard, such as (1) What are the objectives of improving science education in the Philippines?, (2) How do these relate to Philippine national and educational goals?, (3) Are science curricula relevant to needs of Filipino students?, (4) How can science education provide needed knowledge, skills, and attitudes for development?; suggests that a serious shortcoming is lack of attention to means for evaluating whether changes in Philippine science education are accomplishing their purpose.

3237. Salcedo, J., Jr., "Science Curriculum in Graduate Education", *Philippine Science Review*, v. 11, no. 5, September-October 1971, pp. 3-7.

Outlines the efforts of the National Science Development Board of the Philippines to deal with the disproportionate relationship between the total number of graduates in all fields and in the sciences on the graduate level; techniques include sponsoring a Science Talent Search to select yearly awardees for undergraduate scholarships for a B.S. degree in selected fields in science and engineering, awarding graduate fellowships, and providing grants-in-aid to cover expenses for the preparation of graduate theses in the physical and life sciences.

3238. Lesaca, R. M., "What is RP's Policy on Environmental Pollution", *Philippine Science Review*, v. 11, no. 5, September-October 1971, pp. 8-11.

Describes the operations of the Philippine National Water and Air Pollution Control Commission, established by the 1964 Pollution Control Law to investigate pollution, establish standards, set up rules and regulations, and require industry to install pollution control and abatement devices, and incorporate such devices in new plants prior to their construction and operation; outlines the Commission's procedures for handling complaints, public hearings, citations, and prosecution of violators.

3239. Ibe, L. D., "A Report on the Philippine Atomic Energy Program", *Philippine Science Review*, v. 13, no. 1, January/February 1972, pp. 7-18.

Describes the problems considered by the Philippine Atomic Energy Commission in planning a program of atomic energy development, and outlines the major phases of the program decided upon: (1) acquisition and operation of a nuclear research reactor; (2) establishment of a center for nuclear R&D; (3) manpower development; (4) promotion of the use of radioisotopes and application of nuclear techniques; (5) establishment and enforcement of radiological health and safety standards; and (6) special studies and projects; outlines the activities planned for the 1970's, presents tables giving statistics on grants and training course programs, and reports on the actions taken to implement each phase of the program and the progress made.

3240. Wulff, G., "RP — A Possible Stronghold for Natural Products Research", *Philippine Science Review*, v. 11, no. 5, September-October 1971, pp. 17-19.

Asks whether it is possible for a country with limited finances like the Philippines to play an important part in science research internationally, and if so, whether it is justifiable to spend money for this purpose at the expense of pressing needs in the social sphere; describes how the Philippines can play an internationally leading part in one area of chemistry — natural products chemistry; cites the benefits of long-term investments in education and research in this limited area (economic improvements, improvement in quality of students and professors, prevention of brain drain, stimulation of young people's interest in science, and improved standard of living).

PLANNING

3241. White, B., *Source Book of Planning Information*, Shoe String Press, Hamden, Conn., 1971, 632 pp. ($18.00)

Presents a comprehensive bibliography, which is not a mere listing of bibliographic information, but which describes the whole environment within which planning takes place; covers such topics as the history of planning; modern development of

planning; the structure of planning (practice, education, research); the pattern of information usage; development plans and reports; statistical and documentary sources; journals; and guides to the literature; includes a detailed index.

POLLUTION – AIR

3242. Sawyer, R. F., *Atmospheric Pollution by Aircraft Engines and Fuels – A Survey*, Advisory Group for Aerospace Research and Development, AGARD Advisory Report No. 40, March 1972, 33 pp. (Available from National Aeronautics and Space Administration, Langley Field, Virginia 23365.)

Reports the findings of a survey of 45 organizations in the U.S., U.K., France, The Netherlands, Belgium, Germany, and Italy during March through August 1971; describes 27 current or potential problem areas for investigation, and outlines related research work; identifies the 5 most pressing problems: (1) engine emission characteristics, (2) test procedures, (3) nitric oxide formation, (4) carbon monoxide and hydrocarbons at low power, and (5) effect of high altitude emissions; recommends that research be encouraged in all 27 areas, although in some cases only a better definition of the nature of the problem, as opposed to a solution, may be required.

3243. "Down to Earth Space Physics Calculates Car Cleanliness", *New Scientist*, v. 56, no. 824, 14 December 1972, p. 641.

Describes the progress made at the Massachusetts Institute of Technology in creating a model capable of describing and quantifying the processes through which the 3 major air pollutants (hydrocarbons, nitric oxide, and carbon monoxide) are formed in an engine; notes that the researchers have received an NSF grant of $44,600 to continue for another year and extend the analysis to other types of engines, including the Diesel, Wankel, and stratified charge engines; discusses how Ford has already put MIT's model to work.

3244. Swartman, R. K., Ha, V., Julien, M., and Whitney, D. J., "The Solar Era: Part 5 – The Pollution of Our Solar Energy", *Mechanical Engineering*, v. 94, no. 12, December 1972, pp. 23-26.

Describes the benefits of solar radiation, viz., it provides light, food, and oxygen, and has many beneficial effects of health; discusses the possible extreme consequences of air pollution, including another ice age, melting polar ice caps, massive carcenogenic ultraviolet radiation; underlines the drastic lack of the accurate worldwide and long-term solar radiation measurement needed to formulate a hypothesis concerning the future and security of the environment; points out that although air pollution probably can never be entirely eliminated, it can and must be reduced to a rational minimum, and government, industry, and the public must make the effort and pay the price necessary to accomplish this reduction.

POLLUTION – NOISE

3245. *The Economic Impact of Noise*, U.S. Environmental Protection Agency, 31 December 1971, 104 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: $1.00.)

Presents the results of a survey, which demonstrate that substantial costs are associated with noise and its abatement; discusses in detail costs such as those associated with equipment redesign, rights-of-way, and noise insulation; highlights the need for research into the relationship between noise, its abatement, and its impact on such factors as employment, productivity, production costs, property values, and health, as well as research using economic principles to identify and analyze the most cost-effective solutions to noise; discusses Federal and private expenditures for R&D on noise abatement, revealing that these are quite small compared with expenditures for water and air pollution control; includes an appendix giving statistical data, and a bibliography.

3246. "EPA to Launch Noise Control Program", *Environmental News*, 6 November 1972, 2 pp.

Discusses new legislation (signed into law 28 October 1972) which gives the Environmental Protection Agency the primary role in controlling noise, and

announces the first action programs to be carried out under the law – a major study of airport noise and the development of noise standards for trains and motor carriers in interstate commerce; under the new authorities, EPA has the responsibility for coordinating all Federal programs in noise research and control, and while the Federal Aviation Agency retains the authority to set aircraft-noise standards, EPA is required to recommend to FAA any regulations it feels are necessary.

3247. Johnsen, K., "Congress Leaves Noise Control to FAA", *Aviation Week & Space Technology*, v. 97, no. 17, 23 October 1972, pp. 19-20.

Outlines last-minute actions taken by Congress, before adjournment, on the proposed Environmental Noise Control Act, namely, the Congress (1) vested clear control over the issuance of all aircraft noise standards and regulations with the Federal Aviation Administration; (2) eliminated a provision restricting supersonic R&D flights within the U.S.; (3) eliminated a ban on the landing at U.S. airports of supersonic aircraft; and (4) eliminated a requirement that the Secretary of Transportation submit a report to Congress, by July 1973 on methods of financing retrofitting of jet transports to meet FAA noise standards.

POLLUTION – PESTICIDES

3248. Jukes, T. H., "DDT Stands Trial Again", *BioScience*, v. 22, no. 11, November 1972, pp. 670-672.

Reviews the statements given at a consolidated hearing on DDT in Washington, D.C., August 1971 – March 1972, which permitted adequate examination of the charges and countercharges that had accumulated and fulminated during and after hearings on DDT in Madison, Wisconsin, during 1968-69 (e.g., allegations that DDT in the oceans would inevitably cause the extinction of many species of raptorial and fish-eating birds, and by movement through the food chain would exterminate various marine species, and that DDT was a carcinogen); concludes that the testimony at the hearing is sufficient "to demolish scientifically most of the myths regarding the ill-effects of DDT".

POLLUTION – PROBLEMS AND CONTROL

3249. Price, F. C., Ross, S., and Davidson, R. L. (Eds.), *McGraw-Hill's 1972 Report on Business & the Environment*, McGraw-Hill Inc., 1972, 540 pp. ($14.95)

Presents a compilation of environment-related literature selected from McGraw-Hill magazines and newsletters, and other authoritative sources, as an aid to all who must deal with environmental problems and control (e.g., chief executives, process and pollution-control engineers, sanitary and civil engineers, consultants, and lawmakers); Chapters 1-3 deal with policy, laws and standards, and provide information on how to manage an environmental program; Chapters 4-7 concern the technology of clean air, clean water, and solid waste, and consider recycling and reuse; Chapters 8-14 consider the major industrial segments (e.g., cars & fuels, chemical process industries, energy and generating industry), and how they are coping with their problems; Chapters 15-18 concern solutions to industrial noise pollution, the problems of municipal waste treatment, methods of measuring pollution, and special problems (e.g., oil spills, fogging, and odors) and solutions; includes an extensive index.

3250. Wallich, H. C., "How to Live with Economic Growth", *Congressional Record*, v. 118, no. 161, 9 October 1972, pp. S17222-17225 (Reprinted from *Fortune*, October 1, 1972).

Considers various means of controlling environmental pollution without unnecessarily stifling economic growth, and offers some suggestions; proposes that a system of pollution taxes be instituted, contending that as long as resources remain free, industrial polluters have no incentive to abate the pollution beyond the external and somewhat ineffective controls which society places on them.

POLLUTION – RADIATION

3251. *The Effects on Populations of Exposure to Low Levels of Ionizing Radiation: Summary and Recommendations*, Advisory Committee on the Biological Effects of Ionizing Radiations, Division of Medical Sciences, National Academy of Sciences-National Research Council, 1972, 3 pp. (Available from Office of Information, Bureau of Radiological Health, 12720 Twinbrook Parkway, Rockville, Md. 20852.)

Discusses the need, with the advent of nuclear energy, for standards for the major categories of radiation exposure, based insofar as possible on risk estimates and on cost-benefit analyses; predicts that, in the foreseeable future, the major contributors to radiation exposure of the population will continue to be natural background and medical exposures; suggests that man-made and medical exposures can be reduced without impairing benefits, and that, to this extent, exposures permitted by the current Radiation Protection Guide are too high; sets forth some general principles concerning all sources of radiation, including guidelines for the nuclear power industry, which is of particular concern to the general public at this time.

3252. *Estimates of Ionizing Radiation Doses in the United States: 1960-2000*, Report prepared by an interagency Special Studies Group, 1972, 150 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402, Price: $1.50.)

Provides estimates of radiation doses from all sources; sources covered include: the natural background, medical applications, fall out, nuclear power facilities, and TV receivers and other consumer products; the estimates reveal that medical radiation use contributes ~90% of all man-made radiation doses, while nuclear power sources account for much less than 1%.

POLLUTION – WATER

3253. Westman, W. E., "Some Basic Issues in Water Pollution Control Legislation", *American Scientist*, v. 60, no. 6, November-December 1972, pp. 767-773.

Examines contrasting perspectives (technological and ecological) on the regulation of effluents which underlie current debates on water pollution legislation; summarizes the major differences between the two viewpoints, particularly in the approaches to such key legislative issues as water-quality goals, modes of treatment and classification of pollutants, mode of monitoring the success of pollutant removal, and legal point of control; offers a conclusion, suggested by the framing of the ecological approach, viz., that workable methods of disposal are available which would permit the elimination of discharges into the water or air by recycling materials to the land.

3254. Miller, S., and Lewicke, C., "The Business of Water Pollution", *Environmental Science & Technology*, v. 6, no. 12, November 1972, pp. 974-979.

Presents a report dealing with the roles of: (1) the companies in the growing water pollution control industry (the views of company spokesmen as to the company's role); (2) equipment suppliers and their trade association, Waste Water Equipment Manufacturers Association; and (3) consulting engineering firms and technical experts who basically are members of the Water Pollution Control Federation.

3255. "EPA Promises Tough Enforcement of New Water Pollution Law", *Chemical & Engineering News*, v. 50, no. 45, 6 November 1972, p. 17.

Presents remarks by J. R. Quarles, Jr., the Environmental Protection Agency's counsel and assistant administrator for enforcement, in a speech before an American Bar Association National Institute meeting; according to Mr. Quarles, EPA's plans for enforcing the new water pollution control law to include the establishment of precise, detailed abatement requirements that will be enforced through streamlined legal procedures and heavy penalties for violators, and the EPA is already acting to implement the regulation which requires not only all industries but also all municipalities to obtain discharge permits.

POPULATION

3256. Johnson, W., "Population Growth: The Businessman", *Vital Speeches of the Day*, v.

38, no. 24, 1 October 1972, pp. 758-759.

Discusses the problems resulting from overpopulation, such as increased pollution, depletion of natural resources, and an increased demand on the economy; outlines other factors which contribute to these problems, e.g. affluence, technology (especially faulty technology), and wastefulness arising from the belief that world resources are unlimited; concludes that these factors will have to be dealt with immediately, and "stabilization of population will make easier . . . efforts to overcome . . . pollution and overuse of natural resources"; urges strong support of population-control measures by businessmen "for their own profit and the good of the nation".

3257. "A Hint of ZPG", *Nature*, v. 240, no. 5381, 15 December 1972, p. 375.

Reports that the U.S. Government has released data showing that during the first 9 months of 1972, the birth rate in the U.S. fell to 75.3 births per thousand women of childbearing age – a rate which, if maintained, would result in an average of 2.08 children per family, or just below the 2.1 level needed for zero population growth; indicates that even so, U.S. population will continue to grow to 320 million; calls attention to the new Chicago Biomedical Center for Population Research and the 26 Ford Foundation grants for studies of population policies.

PRIORITIES FOR R&D

3258. Lecht, L. A., *Changes in National Priorities During the 1960s: Their Implications for 1980*, National Planning Association, 1972, 53 pp. (Available from National Planning Association, 1606 New Hampshire Ave., N.W., Washington, D.C. 20009. Price: $1.50.)

Analyzes spending patterns and identifies the shifts in priorities occurring in the U.S. during the 1960s, which for the most part involved areas in which government spending – largely Federal – was the predominant element (e.g., national defense, R&D, international aid, and agricultural support); major indications of the study include: (1) if the spending patterns of the 1960s continue for another decade, there will be large gaps between anticipated levels of expenditure in many goal areas and those estimated to be required to achieve goals; (2) the problem of priorities will continue to be an important issue in the 1980s; (3) the pace of economic growth in the 1970s will be the most important single variable determining the extent to which resources will be available to pursue goals.

3259. "Research Foundation Revamps Grants Policy", *Chemical & Engineering News*, v. 50, no. 50, 11 December 1972, pp. 15-16.

Reports that the Engineering Foundation has revamped its grant policy to broaden the types of projects and project areas in which the New York City Organization is accepting proposals; outlines the project areas specified by the new policy, which fall into 2 groups, covering innovative approaches to the solution of major national problems and development of engineering principles and techniques for the future.

3260. "Federal R&D Taking New Directions", *Astronautics & Aeronautics*, v. 10, no. 11, November 1972, pp. 10-11.

Reports National Science Foundation findings which indicate an upward trend since 1970 in Federal support of R&D, with the Federal R&D obligation total expected to rise from $15.5 billion in FY 71 and $16.8 billion in FY 72 to an all-time high of $17.8 billion in FY 73; the relative allocation of funds shows some shift from development towards basic and applied research, with the development share of the R&D total continuing the long-term decline and with industry continuing to take the largest share of R&D funds by a wide margin.

3261. Morrison, J. A., "Science Policy Studies in Multidisciplinary Fields", *Science Forum*, v. 5, no. 6, December 1972, pp. 23-24.

Reviews three reports that have resulted from detailed studies of the problems of and prospects for fundamental research in multidisciplinary fields: (1) *Materials* – stresses the weakness of this report, e.g., it is merely a superficial summary of several existing publications, and is based on 3-year-old questionnaires which do not reflect the more recent fundamental change in the support of materials

research in the U.S.; (2) *Computer Science* (see Ref. 3016) -- suggests that this report represents a plea for more balanced development with greater emphasis on basic research; (3) *Brain and Behavior* -- recommends this report as a sound capsule treatment of multidisciplinary research -- the report providing a definition of the field, a short discussion of its timeliness and promise, an assessment of brain research at various levels, a description of the benefits of such research to society, and a summary of the difficulties of encouraging multidisciplinary research in Europe.

3262. "Federal Support: Boon for Academic Chemists", *Chemical & Engineering News*, v. 50, no. 47, 20 November 1972, pp. 12-13.

Presents the results of a Federal interagency survey (covering the period FY 1969 through FY 1972) which discloses which agencies support which types of research, and the relative priorities among subdisciplines of chemistry and their growth rates; data presented cover principally basic research and some applied studies, but specifically exclude developmental work; presents tables depicting spending on chemistry research by agency and research area, which reveal a $14.8 million increase in Federal support for chemistry research over the 4-year period.

3263. "NSF's RANN Group (Research Applied to National Needs) Has $87 Million in FY-73", *Research/Development*, v. 23, no. 11, November 1972, p. 18.

Outlines major aspects of the RANN program: (1) funds are to be divided, mostly through Academe, among research on earthquakes and weather modification, biomedical analysis, urban engineering and excavation technology, and on energy resources and analysis, with energy research getting the lion's share; (2) $20 million each has been allotted to the National Science Foundation and the National Bureau of Standards for an experimental R&D incentives program, which reflects the Nixon Administration's desire to "unlock" more R&D in the private sector, to bolster employment and the balance of payments; and (3) the entire RANN program is expected to require about 500 additional professor man-years; also, NSF's charter has been amended to permit performance of technology assessment, and $5 illion has been allotted for TA for FY 73-74.

3264. Shapley, D., "COPEP to Rock RANN's Boat", *Science*, v. 178, no. 4057, 13 October 1972, p. 145.

Presents details of a study on the program of Research Applied to National Needs (RANN), to be conducted by the National Academy of Engineering's Committee on Public Engineering Policy (COPEP) at the request of the National Science Foundation (NSF); the study will examine through 6 panels the goals, programs, and administration of RANN; outlines individual priority areas to be considered: energy, human resources, community development, natural hazards and disasters, growth and environment, and an area termed "targets of opportunity", the task of the panel covering this area being to cross-examine other possibilities and proffer fresh viewpoints; suggests that NSF's request for the study was prompted by the Foundation's need for advice on apportioning the funds allotted for the program (current budget about $70 million, with prospects for a significant increase next year).

R&D CLASSIFICATION

3265. Lord Rothschild, "Forty-five Varieties of Research (and Development)", *Nature*, v. 239, no. 5372, 13 October 1972, pp. 373-378.

Lord Rothschild presents his personal views about the terminology used to describe R&D, and the need for clarification and classification of the various types of research; presents a glossary covering 45 types of research, which includes comments on the use of the various terms.

RESOURCE MANAGEMENT

3266. "Gigantic R&D Effort Needed in Resource/Environment Tangle, not Short-Term Solutions, Technological 'Miracles': Du Pont Chief", *Research/Development*, v. 23, no. 12, December 1972, p. 6.

Presents highlights of a speech by C. B. McCoy, President of the Du Pont Company, in which he urges scientists and engineers to play a bigger part in making socio-economic decisions concerning technology; according to McCoy, "government . . . should consider that steps taken to reduce pollution can also place new strains on scarce resources", and a vast amount of R&D is needed to extend the basic understanding of life and resource systems, to create new materials to improve the efficiency of extraction and utilization of natural resources, and to explore basic energy systems ranging from nuclear power to geothermal and solar power.

3267. *Environmental Aspects of Natural Resources Management*, presented at United Nation's Conference on the Human Environment, Stockholm, Sweden, 5-16 June 1972, 101 pp. [Available by accession number (PB-211-133) and title from National Technical Information Service, Springfield, Va. 22150. Price: $3.00.]

Reviews the major issues that have aroused worldwide concern for the human environment, and led to reconsideration of the traditional concepts of resource management; discusses the need for an integrated approach to resource management, and outlines the principal elements of this approach; offers recommendations for national and international action, grouped according to sectors of economic activity (such as agriculture, forests, wildlife, water, and energy); summarizes (for the convenience of governments) recommendations for international action, which are concerned chiefly with: (a) international support for research, study, and demonstration projects; (b) establishment of cooperative surveys or monitoring systems; (c) the adoption of measures to ensure transfer and exchange of information; (d) the need for international agreements; and (e) supporting measures such as training and technical and financial assistance.

3268. *Estimated Use of Water in the United States in 1970*, U.S. Geological Survey Circular 676, 1972, 37 pp. (Available from the Director, U.S. Geological Survey, Washington, D.C. 20242.)

Reveals that U.S. consumption of water from surface and groundwater sources in 1970 averaged about 370 billion gallons per day or 1,800 gallons per capita per day; approximate increases over 1965 in withdrawals of water for the 5 principal uses: (1) public supply (domestic, commercial, and industrial), 13%; (2) rural (domestic and livestock), 13%; (3) irrigation, 8%; (4) self-supplied industrial (mainly in electric-utility thermoelectric plants), 25%; and (5) hydroelectric power, 22%.

3269. *Elements of a National Materials Policy*, A Report of the National Materials Advisory Board, National Research Council to the National Commission on Materials Policy, August 1972, 66 pp. (Available from National Commission on Materials Policy, 2025 M Street, N.W., Washington, D.C. 20506.)

Identifies the issues and problems in 7 major areas central to the formulation of a coherent and durable national materials policy: (1) abundances of mineral commodities and problems affecting future primary supplies; (2) implications of environmental protection policy for national materials policy; (3) recycling, substitution, synthesis, and design; (4) extractive metallurgy and mineral processing; (5) governmental incentives and controls; (6) international implications of materials policy issues; and (7) manpower and facilities; the Committee concludes that the industrial future of the U.S. must be based on more abundant domestic resources and directed away from dependence on materials in short supply, and that the alternative "is progressive deterioration in the mineral position of the U.S.".

3270. "Further Work on a National Materials Policy", *Congressional Record*, v. 118, no. 161, 9 October 1972, pp. S17225-17229.

Reprints an analysis and a summary of a week-long Engineering Foundation Research Conference on "Some Selected Programs of National Materials Policy" held at Henniker, N.H., 31 July-4 August 1972; was called to discuss and review major issues of concern to the Commission on Materials, and 8 main topics were considered, including central government planning and coordination, the possibilities of recycling, and the opportunities and responsibilities of industry in the materials area.

3271. "Electronic Materials: Research Directions, Procurement Problems", *News Report (NAS, NRC, NAE)*, v. 22, no. 8, October 1972, p. 4.

Reviews the major findings of a committee of the National Research Council's Materials Board, which examined the status of solid-state electronics technology in relation to present and prospective needs voiced by Defense Department engineers, and in relation to possible civilian applications of this technology; the work led to 2 reports: the Committee's report on *Materials and Processes for Electron Devices* and a NMAB panel report on *Yield of Electronic Materials and Devices;* the panel report recommends special attention to improved specification and procurement practices, interagency sharing of semiconductor reliability and cost information, and improved coordination of present industry and Government efforts to establish procedures for assurance of high reliability in semiconductors.

3272. Valery, N., "Place in The Sun for Helium", *New Scientist*, v. 56, no. 822, 30 November 1972, pp. 496-498, 500.

Reviews the history of the development of helium technology and conservation in the U.S., which appeared, until recently, to represent a far-sighted policy; examines the reasons for abandonment of the policy and the collapse of the helium market; lists the uses of helium along with relative amounts needed; predicts that with its existing massive reserves of commercial helium and its enormous investment in helium technology, the U.S. will be in a monopoly position when the helium-based electricity boom occurs, and suggests some options open to European helium users.

SCIENCE POLICY BIBLIOGRAPHIES

3273. *Current Literature on Science of Science,* Research Survey and Planning Division, CSIR, v. 1, no. 10, October 1972, 18 pp. (Available from Research Survey and Planning Division, CSIR, Rafi Marg, New Delhi-1, India.)

Contains 53 annotated references to science policy literature published chiefly during 1972 in 21 journals, listed under 26 headings, including basic research, science and technology standardization, science and politics, and individual countries (e.g., China, Mexico, Nigeria, and the U.S.S.R.).

SCIENCE POLICY STUDIES

3274. Caldwell, L. K., and Siddiqi, T. A. (Comp.), *Science, Technology, and Public Policy: A Guide to Advanced Study,* Indiana University, School of Public and Environmental Affairs, April, 1972, 512 pp. (Limited number of copies available from Indiana University, School of Public and Environmental Affairs, 400 E. Seventh St., Bloomington, Ind. 47401.)

Presents outlines of topics, questions, and readings intended to serve as guides to the study of selected aspects of public policy for science and technology, and their impact on society and public affairs; presents extensive bibliographies correlated with the outline for each topic. The material is organized according to 15 major topics, grouped under 3 categories: I. *Science and Technology as Social Forces* — the 5 topics in this section introduce the student to the study of the effects of science and technology in modern society, and afford a background for the remainder of the course; II. *The Organization of Science and Technology* — the 5 topics comprising this section examine the way in which the technoscientific enterprise of modern society is put together, but with emphasis on the machinery of government-science relationships (rather than on such relationships as those of science and technology to manufacturing, commerce, or agriculture); III. *Policy Problems of Science and Technology* — Science Policy Studies — main focus of the 5 topics comprising this section is on problems generated by the growth of technoscience, and the policy issues that arise as a consequence of these problems and of the efforts of society to cope with them.

3275. Donnison, D., "Research for Policy", *Minerva*, v. 10, no. 4, October 1972, pp. 519-536.

Describes the need for awareness of the contributions which research can make to

policy, in view of the increasing influence of governments and their increasing investment in research; points out that while much of the published doctrine available to those who spend public funds on research has been derived from work on the development and application of new technologies, decisions about policy (including technological policy) actually "emerge from a different sort of process -- a continuing debate, to which research workers contribute on equal terms with many others, and in which they seldom apply the findings of their research in a direct technological sense"; discusses this process as it applies to social policies, and considers the types of research workers best suited to conduct policy research.

3276. *Analytical Methods in Government Science Policy -- An Evaluation*, Organisation for Economic Co-operation and Development, 1972, 89 pp. (Available from OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006. Price: $2.00.)

Presents a report of the OECD Committee for Science Policy, which: (1) describes some of the essential features of policy making and of science and technology that must be considered by analysts; (2) describes the opportunities and dangers in using analytical techniques; (3) discusses specific techniques -- their uses and abuses -- and summarizes the advantages and disadvantages of various approaches; (4) discusses the use of analytical techniques in organizations; (5) presents the conclusions, which underscore the need for effective use of analytical techniques to assess the myriad impacts of science and technology, to make choices among alternative programs, and to harness science nd technology more effectively to a greater number of national objectives.

SCIENTIFIC INSTITUTIONS

3277. *National Academy of Sciences, National Academy of Engineering, National Research Council, Annual Report, 1968-1969*, 15 February 1972, 414 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: $2.00.)

Contains five sections which report: (I) the activities of the National Academy of Sciences (NAS) committees; (II) the activities of the National Academy of Engineering (NAE); (III) the activities undertaken jointly by the two Academies; (IV) international activities of the overall organization; and (V) the activities of the National Research Council (NRC); the National Research Council activities are described under 5 broad headings: (1) Questions of Public Policy, (2) Services to Government Agencies, (3) Applications of Science and Technology to the Public Welfare, (4) Furtherance of Research, and (5) Manpower and Education; includes 5 appendixes covering, for example, the meetings and organization of NAS and NAE and the organization of NRC, and provides a selected bibliography of NAS-NAE-NRC publications (1968-1969).

3278. "Organizing Organization", *Science Policy*, v. 1, no. 5, September/October 1972, p. 3.6.

Points out that, until now, no mechanism has existed in the U.S. through which individual scholars, scientists and program staff of institutions of learning could criticize proposals of national agencies, even though such proposals are offered on their behalf; now, however, a body known as Organization Response is maintaining a register of professional interests in the purposes and general functions of educational institutions which can be used to invite review of and comment on plans which may affect their policies and social relations; the hope is to minimize the possible consequences of plans by exposing them to consideration by those who have carefully thought about such institutions, their social involvements, and their unmet responsibilities.

SOCIETY -- SCIENCE INTERACTION

3279. "Science and Society: Follow-up of the Brooks Report", *OECD Observer*, no. 60, October 1962, pp. 13-14.

Presents highlights of a seminar on the problems of science and society (held at St. Paul de Vence, France) organized to aid in the realization of the Brooks Report's recommendation of new social priorities for scientific research; participating were

50 scientists representing a wide variety of disciplines; the most discussed problem involves the locus of the decision-making process, and questions were raised as to who is to decide how the priorities and resources should be assigned, whether scientists participate and if so how, and how collaboration on science policy can be broadened to involve the general public; the seminar also underscored the need for improved communication of scientists with the decision makers, with those knowledgeable about social conditions, and with the public at large.

3280. "Science and Society: More Information Needed", *Science Policy*, v. 1, no. 5, September/October 1972, p. 6.2.

Analyzes the discussions which took place at the Colloquium "Science and Society" held at Saint Paul de Vence, France, in June 1972, and which focused on 4 topics: research and the university, the ideology of science, science and the authorities, and science in economic and social development; presents a few impressions conveyed by the discussions: a number of specialists on the subject of science and its place in society – i.e., certain historians, sociologists, and even science administrators – have difficulty communicating with scientists with any attitude other than dogmatism; the great majority of scientists are much aware of present problems, but are disconcerted by their size and complexity; all agreed that there is a need for adequate information – a dialogue between the scientific community and society.

3281. Horgan, J. D., *Technology and Human Values: The Circle of Action*, Preprint of paper (No. 72-WA/TS-4) presented at the Winter Annual Meeting of The American Society of Mechanical Engineers, New York, N.Y., 26-30 November 1972, 7 pp. (Available from ASME, United Engineering Center, 345 E. 47th St., New York, N.Y. 10017. Price: $3.00; $1.00 to ASME members.)

Describes the divergent views regarding the impact of technology (e.g., "it is neutral", "it dominates man and may even destroy him", "it has a 'super-humanizing' rather than a dehumanizing effect"), and considers the interrelationships of technology and human values; delineates the responsibility of the engineer, i.e., to ponder and disseminate the possible effects of his innovations on the human-value system; considers possible actions which could enable man to come to terms with technology, and suggests that the effectiveness of these actions will depend strongly on how well man has come to understand the interrelationships of technology and human values.

3282. Albertson, P., and Barnett, M. (Eds.), "Environment and Society in Transition (Scientific Developments, Social Consequences, Policy Implications)", International Joint Conference of the American Geographical Society and the American Division of The World Academy of Art and Science, April 27-May 2, 1970, *Annals of the New York Academy of Sciences*, v. 184, 7 June 1971, 699 pp.

Presents papers and discussions by the 100+ Conference participants; Part I consists of 41 papers under 5 headings: (a) Space and Earth Sciences, (b) Biological and Medical Sciences, (c) Physical Sciences and Engineering, (d) Anthropology, Sociology, and Psychology, (e) Economics, Political Science, and Law; Part II presents transcripts of discussions by the 5 working groups: (a) Cultivating Resources, (b) Population, Health, and Family, (c) Scientific Knowledge, Education, and Communication, (d) Decision Processes, (e) Economic and Social Policy; Part III covers the World University Program; Part IV includes Glenn Seaborg's dinner address, "The Positive Power of Science"; and Part V gives a Summary and Conclusions by the Conference co-chairmen.

3283. Lavoie, F. J., "Look Who's Getting Involved", *Machine Design*, v. 44, no. 26, 2 November 1972, pp. 82-88.

Discusses the increasing involvement of engineers in demonstrating for and speaking out on issues that affect them, and for causes both self-serving and for the common good; describes the activities of several organizations dedicated to increasing the social responsibility of engineers and scientists, such as: one which opposes the SST and favors a curb on ABM deployment, another which is dedicated to improving the environment, and others which protest against the Vietnam War and the development of ever more destructive weaponry; also notable is the establishment of a "Clearinghouse for Professional Responsibility", through which professionals can lodge complaints, without fear of backlash, against any of their

companies' policies or products which they feel pose a threat to public health or safety.

3284. "Selling the Public on Science: NSF Backs Big Sales Pitch", *Science & Government Report*, v. 2, no. 17, 1 December 1972, p. 5.

Presents brief summaries of the projects being funded by the National Science Foundation under a program designed to allay public fears of science and drum up support for increased spending on research; among these are: (1) a project to catalog the benefits of scientific research to man and society; (2) a project "to bring to the community . . . a new awareness of what science is doing and what it can do in the future in meeting environmental problems"; and (3) a project for the development of programs aimed at communicators, the scientific community, decision-makers, young people, and the general public, which may involve publication of a journal (tentatively entitled *Science and Media*) whose need arises from "increased uncertainties in understanding the exact role science can play".

3285. Haberer, J., "Politicalization in Science", *Science*, v. 178, no. 4062, 17 November 1972, pp. 713-725.

Reviews the emergence of science from the "ivory tower" to the point where, "in both its internal affairs and in its relations to the rest of society, science has become deeply immersed in political problems, issues, and processes"; discusses the factors influencing the nationalism and internationalism of the scientific community, e.g., World War I which created a rift in the international scientific community and a shift toward nationalism; examines the professionalism of science, the implications, and the results, such as the stronger ties between science and society brought about by the dependence of professionalism on large-scale societal investments and public support of scientific institutions; considers the ramifications of a science-government partnership, and the role of science in the making of public policy, and outlines fundamental questions that must be dealt with, primarily concerning the impacts and consequences of the science-politics interface.

3286. Livingston, D., "Science Fiction and Science Policy", *sppsg Newsletter*, v. 3, no. 9, November 1972, pp. 7-8.

Discusses the particular relevance of science fiction to the field of science, technology, and public policy, giving examples: (1) it often reflects two root assumptions of science policy (that some choice is available among alternative futures, and that it matters how this choice is exercised), and can serve to highlight the need for technology assessments; (2) it can serve to enliven the imagination of science policy analysts by stories that describe the impact on government and society of such technologies as bioengineering, nuclear fusion plants, undersea mining and habitation, weather control, and communications satellites; (3) it serves to reflect general social attitudes toward science and technology; and (4) it can serve as a medium for engaging students in the basic questions of choices, priorities, and values inherent in science policy issues.

3287. "Nobelists Muse about Science", *Impact of Science on Society*, v. 22, no. 4, October-December 1972, pp. 281-339.

Presents the views of 5 Nobel Prize winners on how scientific research and technology affect humans, the common thread being a strong plea for common sense in applying our resources and capabilities to convert invention into rational, essential uses; authors are E. P. Wigner (Ethics in the Relationship between Science and Society), J. Tinbergen (Society Needs to Organize the Structures and Uses of Science), G. Natta (Scientific Progress and the Human Condition), F. M. Burnet (The Implications of Global Homeostasis), A. Szent-Tyorgyi (Knowledge, Intelligence, and Their Sane Use), and R. Cassin (Science and Human Rights).

3288. "Avoid Military Research, Casimir Tells Physicists", *Physics Today*, v. 25, no. 12, December 1972, p. 75.

Reviews a speech by H.B.C. Casimir, president of the European Physical Society, on the relationships between science and technology delivered at the September IUPAP meeting in Washington, D.C., and presents some of his recommendations, e.g., that academic scientists should not work on military technology, and that industry should not attempt to influence basic research programs in the

universities.

3289. "Physics and Society", *sppsg Newsletter*, v. 3, no. 8, October 1972, pp. 10-12.

Presents excerpts from an address by H.B.G. Casimir to the XIV International Congress on the International Union of Pure and Applied Physics; Casimir emphasizes the increasing dependence of physics on the products of advanced technology, and describes this interactive system of physics and technology as a science-technology spiral; he also expresses concern about "the influence of science-based technology not only on the waging of war but also on the destruction of the environment and the nature of human relations", and suggests that the "best chances for gaining control over the ominous [science-technology] spiral lie in a plurality of controls, in an independence of the several participating groups [e.g., industry, the academic community, and the Military], and in openness", viz., free discussions and publications.

3290. Schroeer, D., *Physics and Its Fifth Dimension: Society*, Addison-Wesley, Reading, Mass., 1972, 378 pp. ($4.95)

Presents an extensive historical survey of science and culture, which tends to support his view that the split between the scientific and humanistic cultures has existed since ancient times; provides an analysis of a multitude of interactions (both friendly and hostile) that have occurred between science and society by means of concrete examples; among the more recent interactions are: ideological control of science, art, radioactive dating, the development of nuclear weapons, nuclear medicine, science funding, science in the universities, NASA, and the energy crisis; also examined are attempts at ideological control of science by Nazi Germany, as well as some examples from the U.S. and the U.S.S.R.

3291. Shapely, D., "NSF: Engineers Policy Group Urges More Software for RANN", *Science & Government Report*, v. 2, no. 18, December 1972 pp. 4-5, 7; see also *Science*, v. 178, no. 4067, 22 December 1972, pp. 1270-1273.

Presents highlights of a report by a National Academy of Engineering Committee which conducted an extensive evaluation of the RANN program; the report calls for considerable redirection or reorientation, emphasizes that "applied social research . . . is as critical to the solution of many of our society's problems as technical research", and urges work aimed at overcoming institutional, policy, and legal barriers to the effective delivery of such services as health, education, urban transportation, and fire and police protection, among others.

SOUTH AFRICA

3292. "University Agriculture", *Nature*, v. 239, no. 5372, 13 October 1972, pp. 361-362.

Discusses the confusion and questions concerning the incorporation of South African departments of Agriculture into the university structure (by April 3, 1973), a recommendation by a Cabinet Committee which has now been adopted by the Cabinet; chief concerns are the high cost of training agricultural students (because of the low staff-student ratio) and the question of how students are to be subsidized in the future; it is hoped that a review of university finances now being conducted can clarify the issues, if the commission conducting the review reports soon.

SPACE – INTERNATIONAL COOPERATION

3293. "U.S. Gives Views on U.N. General Assembly Items on Outer Space", *U.S. Department of State Bulletin*, v. 67, no. 1746, 11 December 1972, pp. 683-692.

Presents the texts of statements by 2 U.S. Representatives to the U.N. on specific draft resolutions; G. Bush discusses the Earth Resources Technology Satellite and the post-Apollo programs, comments on the legal aspects of U.N. space related work, and voices U.S. objections to a Soviet proposal to restrict the use of artificial earth satellites for direct television broadcasting; R. C. Tyson explains the U.S. negative vote on a draft resolution (2916) incorporating such restrictions; he also points out, in connection with a resolution (2914) on international action for the mitigation of the harmful effects of storms, that much research is needed

before artificial control of storms becomes safe and practical; includes the texts of 4 General Assembly draft resolutions (2914 through 2917) dealing with the U.N. role in international cooperation in the peaceful uses of outer space.

3294. "U.S. to Provide Launch Assistance for Peaceful Satellite Projects", *U.S. Department of State Bulletin*, v. 67, no. 1741, 6 November 1972, pp. 533-534.

Presents an announcement of a new policy whereby the U.S. will provide launch assistance to interested countries and international organizations for those satellite projects which are for peaceful purposes and are consistent with obligations under relevant international arrangements; presents a White House fact sheet giving the conditions of the new policy.

3295. Harvey, M. L., Harvey, D. L., and Ciccoritti, L. C., *U.S.-Soviet Cooperation in Space: A Documentary Accounting*, Monographs in International Affairs, 1972. (Available from Director of Publications, Center for Advanced International Studies, Washington Research Division, Suite 811, 1225 Connecticut Ave., N.W., Washington, D.C. 20036. Price: paperback, $4.95; hardcover, $5.95.)

Examines and analyzes recent developments and current trends and prospects for U.S.-Soviet space cooperation against the background of a comprehensive accounting of previous efforts at cooperation extending back to the International Geophysical Year and continuing through the Eisenhower, Kennedy, Johnson, and early Nixon Administrations; interrelates space policies of both nations with their basic foreign policies and objectives and with their efforts to advance science and technology, and to use science and technology as instruments of policy; includes extensive documentation.

3296. "U.S./USSR Planners Agree on Joint Manned Space Mission", *Machine Design*, v. 44, no. 29, 30 November 1972, p. 18.

Presents the timetable for the joint mission, agreed upon by the U.S. and the Soviet Union in Moscow in October 1972: (1) Soyuz target launch date -- 15 July 1975; (2) Apollo to have 5 launch opportunities -- beginning 7-1/2 hr after Soyuz lifts off and extending into the 5th day after the Soviet launch; describes the joint crew-training sessions scheduled to begin in the U.S. next summer, and continue in Russia next fall; also describes plans for meetings of the 5 joint working groups at the U.S. Manned Spaceflight Center and in Moscow.

3297. Winston, D. C., "Germans Threaten Withdrawal from Launcher Development", *Aviation Week & Space Technology*, v. 97, no. 20, 13 November 1972, p. 17.

Describes conflicting views of West Germany and France regarding the European Launcher Development Organisation (ELDO) program and future space participation with the U.S., the Germans opposing further finding of the so far unsuccessful Europa launcher series and favoring development of payload packages and cooperation with the U.S. in the post-Apollo program, with the French supporting development of a European launch capability independent of the U.S.; suggests that West Germany's withdrawal from the ELDO program would probably be keyed to a firm U.S. commitment to launch European space payloads, particularly the German-French geostationary communications satellite, Symphonic, in the second half of 1974.

SPACE -- PROGRAMS AND GOALS

3298. "Belt Tightening in the Office of Space Science", *Nature*, v. 240, no. 5378, 24 November 1972, pp. 177-178.

Outlines project delays and cancellations in NASA's Office of Space Science due to "acute and chronic shortages of money" resulting from, among other things, the failure of 4 launchers in 1970 and 1971; describes some consequences, including elimination of the Grand Tour mission to the outer planets, delay of the first 2 scheduled launches of the High Energy Astronomical Observatories, deferrment of the Interplanetary Monitoring Platform series, jeopardy of the advanced Orbiting Solar Observatory launches, and paring of the Venus-Pioneer missions.

3299. Gillette, R., "The Aftermath of Apollo: Science on the Shelf?" *Science*, v. 178, no. 4067, 22 December 1972, pp. 1265-1268.

Discusses the effort that will be required to collect and process the data, to care for all the photographs, and to analyze, preserve, and catalogue the collection of moon rocks and soil obtained during the Apollo missions, and describes the concerns of lunar scientists that these will not receive the study and protection from contamination and deterioration which they deserve 3 to 5 years hence when public interest has waned and NASA will be funding new ventures; cites a Lunar Science Institute report which emphasizes that the end of Apollo "leaves the scientific tasks undertaken . . . substantially unfinished" and recommends steps for the care and study of the lunar samples.

3300. Gregory, W. H., "Future Moon Probes Outlined", *Aviation Week & Space Technology*, v. 99, no. 25, 18 December 1972, pp. 53, 56-57.

Reviews recommendations for future lunar missions as listed in a report by the Lunar Science Institute (rather than NASA), covering a polar orbit nonlanding mission and remote sensing from lunar orbit; longer range suggested missions include a polar landing, revisiting an Apollo site, extended mare exploration and highlands sampling, and explorations of farside uplands, younger ringed basins, younger volcanics, lava sequences, areas of transient activity, and varied rille terrains; includes recommendations from the report, such as the establishment of an Apollo photographic archive and non-NASA advisory committees.

SPACE – SHUTTLE

3301. "Shuttle: Real Work on the Design Now Underway", *Astronautics & Aeronautics*, v. 10, no. 11, November 1972, pp. 8-10.

Describes the design and program plans for the National Aeronautics and Space Administration's space shuttle which were discussed by NASA's Space Systems Committee in a meeting held (1) to review status reports on the shuttle; (2) to make the Committee's recommendations on such items as the major thrust for NASA in the 1980's, alternative design approaches, and the feasibility of a shuttle vehicle test program; (3) to review the need for a space tug; and (4) to discuss the specific manned-spaceflight proposals for the NASA FY 74 budget.

3302. Yardley, J. F., "Space Transportation", *Astronautics & Aeronautics*, v. 10, no. 12, December 1972, pp. 30-31.

Outlines the discussions to be held in the Space Transportation segment of the 9th Annual Meeting of the AIAA in special sessions focusing on the space shuttle system; discussions will present an overview of the space-shuttle design, plans for its development and operation, the status of its technology, and program benefits.

STATE AND LOCAL SCIENCE ACTIVITIES

3303. *Action Now Partnerships – Putting Technology to Work*, Report on National Action Conference on Intergovernmental Science and Technology Policy held in Harrisburg, Pa., 2-23 June 1972, 33 pp. (Available from Pennsylvania Office of Science and Technology, Department of Commerce, Room 400, South Office Building, Harrisburg, Pa. 17120.)

Presents the action resolutions advanced by the Conference: I. State and Local Representation on Science and Technology Councils; II. Strengthening State and Local Government through Applied Science and Technology; III. Federal-State-Local Partnerships in Applied Research and Development; IV. Making Technology Available to All; V. New Institutional Arrangements for Public Service; VI. Using Federal Laboratories in Domestic Programs; and VII. The Public Interest Groups – A Vehicle for Action; the resolutions provide a framework for development and use of public technology to deal with such problems as power plant siting and power failures, flood control, public transportation, air pollution, and solid waste control, and specific recommendations are offered for implementing these resolutions.

3304. "Bridging the Application Gap", *PTI News*, July 1972, pp. 1-2.

Describes the organization of Public Technology and its purpose (to act as the R&D arm of local and state government), and defines its basic functions: (1) to

give cities, counties, and states opportunities to share the costs and benefits of R&D programs; (2) to stimulate the development of new technological solutions to their problems; and (3) to inform its subscribers about new solutions that have been developed by state and local governments; outlines the steps taken by Public Technology to bring about a profitable relationship between local governments and private industry in their support of R&D.

3305. "USCM Adopts Resolution on R&D", *PTI News*, July 1972, pp. 3-4.
Presents the text of a resolution adopted at the 40th Annual Conference of Mayors, which supports President Nixon's efforts to use science and technology on behalf of U.S. city, county, and state governments; calls on the Congress to appropriate at least $250 million in new R&D grant-in-aid funds to enable state and local governments to launch R&D joint ventures with and through their R&D arm, Public Technology, Inc., and the private sector.

3306. "PTI Aids NSF in New Incentives Program", *PTI News*, August 1972, p. 4.
Describes Public Technology's efforts to provide the National Science Foundation with guidance from local and state governments as part of the Foundation's Experimental Incentives Program; at a meeting sponsored by the NSF to discuss the innovative process in the public sector and the opportunities for increased R&D expenditures, local and state government officials concluded that the public services sector offers excellent opportunities for both public and private investment.

SWEDEN

3307. Hawkes, N., "SIPRI: Peace Research Institute Losing Old Staff, Pondering Role", *Science*, v. 178, no. 4058, 20 October 1972, pp. 286-288.
Describes the work of the Stockholm International Peace Research Institute (SIPRI), which consists chiefly of careful examination of masses of military information solely from public sources, sorting out fact from propaganda, and preparing collections of this information; lists major SIPRI publications including: an annual yearbook (a guide to world military expenditures), a 6-volume study of chemical and biological weapons (now in process), and a paperback version (now in preparation) of the Arms Trade with the Third World (published in 1971); discusses the poor sales of these publications, the failure to get the SIPRI's ideas across, the dilemma which SIPRI may face in deciding whether to direct its information to "decision-making elites" or the public at large, and staffing problems.

SWITZERLAND

3308. "Some Problems of Science Policy in Switzerland", *Science Policy*, v. 1, no. 5, September/October 1972, pp. 1.7-1.8.
Presents the views of Science Council President Karl Schmid, who discusses the feasibility of a national research policy for Switzerland, and describes the bases for opposition to science, higher education, and research policies; views on various problems include: (1) to cope with the rapidly increasing number of university students, "creation of additional student places must be the basis of [higher education] policy in the near future"; (2) for a large number of medium and small-sized firms . . . the importance of research by and for industry was not yet sufficiently recognized"; (3) results of research carried out at universities must be made generally available"; (4) the "new concept for Federal research promotion based on economic consideration" recently developed would be an integral part of Swiss Science policy; (5) "in a country in which 70% of the expenditure on research is financed by private enterprise, a 'national research policy' which implicitly includes defining the aims of research cannot be drawn up without reservations, and it would be more realistic to try to work out a set of coherent principles for promotion of research by the Federal Government".

3309. "Extract: Swiss Science Council", *Science Policy*, v. 1, no. 5, September/October 1972, p. 1.8.

Summarizes the findings of the Council with regard to Swiss science and educational policy: (1) in all probability, Swiss science and research policy will soon enter a new phase, with passage of a bill containing new provisions for education and research and calling for increased action by the State to develop research; (2) the Confederation should assume greater responsibility in regard to higher education; (3) the Confederation will need to expand its research commitments, to ameliorate shortcomings or underdevelopment of major scientific disciplines; (4) the Confederation needs to do still more in promoting research from the standpoint of economic and social considerations; (5) promotion of research solely to advance scientific knowledge should be accompanied by increased promotion of research to serve the public interest.

TAIWAN

3310. "Taiwan is Breaking Japan's Grip on Its Engineering", *Chemical & Engineering News*, v. 50, no. 4, 9 October 1972, p. 7.

Reports Taiwan's reaction to Japan's clear intent to recognize the People's Republic of China: the Republic of China government in Taiwan has ruled out further awards to Japanese firms of engineering/construction contracts above $20,000 — unless the firm's bid is at least 20% under those of non-Japanese competitors.

TECHNOLOGICAL INNOVATION

3311. Chisholm, D., "Innovation in Action: Research and Development", *Vital Speeches of the Day*, v. 39, no. 4, 1 December 1972, pp. 103-107.

Describes the R&D laboratory as a "people machine for creating innovations . . .", and delineates the step-by-step system approach to *successful* innovation; emphasizes that "since R&D is an investment in the future, success consists of meeting tomorrow's needs, working under tomorrow's conditions, and success will be measured against the expectations of tomorrow's customers"; discusses the importance of the function of choice in the innovation process, noting that "making the right choice demands comprehensive, all-inclusive thinking capable of welding together the technical reality, the production reality, the reality of the market place, and the reality of social wants"; stresses the importance of identifying current and future consumer needs, examining social trends, and keeping abreast of technical progress through participation in the worldwide exchange of technical information.

3312. "Federal Labs to Validate Performance of Inventions", *Machine Design*, v. 44, no. 31, 28 December 1972, p. 4; see also *Chemical & Engineering News*, v. 50, no. 50, 11 December 1972, pp. 8-9.

Announces the selection of the first project in the National Science Foundation's R&D Incentives Program, which involves the use of Federal laboratories to validate performance of technical innovations aimed at the civil sector; first experiments will be undertaken in those Federal laboratories already equipped to make the kinds of tests contemplated and the starting group will include NASA; among the criteria an innovation must meet for testing are: (1) it must have the potential for advancing the state of the art; (2) there must be a strong or potentially strong public benefit from the idea or product; and (3) the normal market mechanism is not working to advance the idea or product.

3313. "Physics and Physicists in Industry: Two Views", *Physics Today*, v. 25, no. 11, November 1972, pp. 73-74.

Describes talks given by featured speakers at the annual meeting of the American Institute of Physics Corporate Associates in Washington, D.C., September 1972: one discussing the National Science Foundation's Experimental R&D Incentives Program which is aimed at devising and experimenting with ways to overcome "blockages" that now slow down or prevent application of science and technology in industry and government, the other dealing with methods to improve the employment outlook for physicists in industry, and discussing the difficulties encountered when introducing a new technology.

3314. Simpson, R. O., "The Patent System -- Keystone to Technological Progress", Remarks before the American Patent Law Association, *U.S. Department of Commerce News*, 19 October 1972, 11 pp.

Mr. Simpson, Acting Assistant Secretary of Commerce for Science and Technology, reviews the need for continued technological innovation owing to increased international competition and increased demands for high technology; discusses the Government's Experimental Technology Incentives Program, and other Government incentives for technological innovation, including that special priority be given to the processing of applications for patents which could aid in curbing environmental abuses.

TECHNOLOGY ASSESSMENT

3315. "Kennedy Moving Ahead with Technology Office Plans", *Science & Government Report*, v. 2, no. 16, 15 November 1972, p. 7.

Discusses actions being taken by Senator Kennedy (who is virtually assured chairmanship of the OTA Board) and his aides to lay the groundwork for the OTA; e.g., a Kennedy emissary has asked the National Academy of Sciences and several professional societies to suggest criteria for membership of the advisory council that will serve the Board, and the National Science Foundation has been asked to suggest areas that merit high priority for study; presents a statement reflecting the Nixon Administration's view, namely: that "technology assessment is a vital component of technological progress" but "it should not become an instrument of technological arrestment", and "properly conducted . . . it could be highly effective".

3316. "OTA Taking Shape", *Nature*, v. 240, no. 5381, 15 December 1972, p. 375.

Describes the efforts of Sen. Kennedy, who will be chairman of the Policy Board of the Office of Technology Assessment, to transform the to-be-established OTA into an active entity rather than the passive one prescribed in the legislation; mentions the possibility of having the OTA Board hold public hearings and appoint *ad hoc* panels to study specific issues; suggests that former Congressman Daddario may be offered the directorship of the OTA.

3317. "Lack of Money May Delay OTA Startup", *Science & Government Report*, v. 2, no. 18, 15 December 1972, p. 7.

Points out that although the authorization for OTA was passed toward the end of the last Congress, the measure came along too late for any action on the appropriations bill to provide operating funds (set at up to $5 million), and thus startup of OTA may be delayed until spring; identifies the fund-seeking options of OTA supporters: (1) to seek a special supplemental appropriation when Congress convenes in January, or (2) to wait for a large multipurpose supplemental which usually comes up toward the end of April (the option most likely to be adopted).

3318. "Industry Must Act to Insure Strong Voice in Office of Technology Assessment", *Inside R&D*, v. 1, no. 29, 18 October 1972, p. 1.

Suggests that the real power in the OTA will lie with the Policy Board and the advisory council since they will select the projects to be assessed and review assessment findings; the Board will choose 8 persons "eminent in physical, biological, or social sciences or engineering, or experienced in administration of technology" for the advisory council, and industry people could be selected, but lobbying would be necessary if they are to be chosen.

3319. "The Vista of ISTA", *Astronautics & Aeronautics*, v. 10, no. 12, December 1972, pp. 10-12.

Describes the organization, powers, and objectives of the new Office of Technology Assessment (OTA) which, along with the formation of the International Society for Technology Assessment (ISTA), places technology assessment very much in the limelight; lists the members of the Technology Assessment Board, and speculates that Sen. E. M. Kennedy will probably be elected by the 12-member Board as its first chairman; reports that ISTA hopes to spread the word of the impact of both man's hard and soft technology on his social, economic, and environmental well-being; suggests that technology assessment is a new industry

that might mean jobs for thousands of technologists.

3320. *Technology Assessment in State Government*, A Report on a Working Conference and Recommendations for Action, The National Academy of Public Administration, September 1972, 71 pp. (Available from National Academy of Public Administration, 1225 Connecticut Ave., N.W., Washington, D.C. 20036.)

Summarizes the discussions held at the Conference, which centered chiefly on the capacity of States (executive agencies, the office of the Governors, and the State legislatures) to conduct technology assessment (TA), although 3 other topics were considered at some length; (1) the definition of TA when applied to public programs at the State level, (2) the need for TA in State government, and (3) the role of intergovernmental (Federal-State) cooperation in TA; presents panel conclusions and recommendations for State and Federal action; includes 6 appendices comprising various papers on TA, the February 1972 version of the bill to establish an Office of Technology Assessment, and a list of Federal officials knowledgeable about TA.

3321. "Risk-Benefit Analysis: A Needed New Science", *Machine Design*, v. 44, no. 31, 28 December 1972, p. 4.

Presents views of Dr. Phillip Handler, president of the National Academy of Sciences, concerning technology; according to Handler, more technology, not less, is needed if we are to prevent existing technologies from growing awry, and to correct the damage that has been done to the planet; Handler also cites "risk-benefit analysis" as the single skill most in need of cultivation, claiming that we do not begin to know how to evaluate such things as new drugs, food additives, and environmentally related technologies so that intelligent decisions can be made regarding their employment.

TECHNOLOGY TRANSFER

3322. *The National Technology Programs, Utilization of Industry*, Aerospace Research Center, 1972. (Available from Aerospace Research Center, Aerospace Industries Association of America, Inc., 1725 De Sales St., N.W., Washington, D.C. 20036.)

Presents the comments of the aerospace industry in its assessment of the progress of the Nixon Administration in achieving its announced goal of applying the nation's space and defense R&D capabilities to domestic problems; the industry suggests that if the Administration sincerely wishes to revitalize science and technology for civilian needs, it will have to define specific goals and provide clear direction and greater funding; the industry also calls for a national commitment (similar in magnitude to past defense or space programs) that could be initiated in such areas as energy, pollution, health, and mass transportation, but stresses that private firms cannot be expected to enter these fields on a large-scale basis without substantial Federal aid.

3323. *For the Benefit of All Mankind: The Practical Returns From Space Investment*, Report of the Committee on Science and Astronautics, U.S. House of Representatives, October 1972, 77 pp. (Available from Committee on Science and Astronautics, U.S. House of Representatives, Washington, D.C. 20515.)

Presents some 250 examples of present-day and near-term future dividends and practical uses of space research and technology in 13 categories of activity, including communciations, weather forecasting, business and industry, agriculture, the environment, education, medicine, home and market place, and municipal and urban affairs; the most direct benefits are: international television relayed by a network of communications satellites, and improved long-range weather forecasting through data relayed by meteorological satellites; satellites, and remote sensors, which monitor earth resources, the oceans, and the atmosphere provide benefits in several areas (e.g., agriculture, environmental protection); some of the lesser known, but no less valuable, spinoffs include: new consumer products such as lightweight, insulating fabrics and nonflammable materials; many new biomedical techniques (e.g., for monitoring cardiovascular and pulmonary activity, and blood pressure); and applications of space technology in solving problems in the public sector; the Committee concludes that the many benefits already realized, coupled with those in sight for the near-term future, give promise of a continuing and

increasing return on the U.S. space investment.

3324. "'Urban Laboratory' Uses Space Engineering Techniques", *R&D Management Digest*, v. 2, no. 6, December 1972, pp. 9-10.

Describes an experiment in putting advanced technology to work to solve urban problems being conducted in Tacoma, Washington; working in partnership on the project, supported by a small grant from the National Science Foundation, are: (1) the University of Washington Graduate School of Business Administration (focusing on possible changes in city government organization); (2) Boeing Co., which is adapting aerospace knowledge in engineering and systems approach to urban problems; and (3) Tacoma Boatbuilding Co., which is working with the city to develop a new multiservice harbor craft to replace Tacoma's old fireboat; in addition to fighting fires, the new craft would be equipped for patrol and security, pollution control (including oil spills), and rescue and salvage.

THAILAND

3325. *Workshop on Science Planning and Policy in Thailand (Bangkok), 3-6 July 1972: Annual Report*, National Research Council of Thailand, 1972, 49 pp. (Available from Board on Science and Technology for Economic Development, Office of the Foreign Secretary, National Academy of Sciences, 2101 Constitution Ave., N.W., Washington, D.C.)

Reports on the activities of the Workshop, sponsored jointly by the National Research Council of Thailand and the U.S. Academy of Sciences, and describes the focus of the Workshop discussions: (1) human resources and the development of science and technology in Thailand; (2) institutional basis for the development of science and technology, and (3) coordination and planning at sector and national levels of the use of scientific and technical resources for sectorial development; presents general findings and recommendations, as well as those of the working groups in the 5 individual sectors: (Industry and Engineering; Natural Resources and Utilization; Agricultural Production; Medicine, Public Health, and Environmental Quality; Academic Science).

TRANSPORTATION

3326. "Schools Get Dollars for Transportation Research", *Machine Design*, v. 44, no. 26, 2 November 1972, p. 4.

Announces a new program being funded by the Department of Transportation to increase the involvement of universities in the solution of transportation problems, to stimulate innovation, and to advance the scientific fields related to transportation; DOD also hopes to "encourage the development of interdisciplinary teams from the social, ecological, political, economic, and legal fields working with engineers to help solve the most pressing transportation problems at all levels of government"; the program, with a funding of $400 million for FY 1972, will support problem-oriented transportation research by faculty and graduate students.

3327. Mumford, L., "Why We Must Get Back on the Tracks", *Congressional Record*, v. 118, no. 172, 8 November 1972, pp. E9103-9105. (Reprinted from *Sunday Star and Daily News*, Washington, D.C., 23 July 1972.)

Delineates the proper role of the railroad in the U.S. passenger transportation system, and outlines the steps which must be taken to rebuild a balanced transportation network: (1) revise priorities in transportation, and turn the Federal funds allotted to highways over to rebuilding of the entire rail network; (2) restore as many passenger trains as there were in 1950; (3) banish trucks and trailers from all public roads, urban or rural; (4) phase out passenger and freight jumbo jets; (5) allocate public funds not only for redesigning and manufacturing rolling stock, as well as for repairing neglected equipment, but also for training and reassembling a new generation of railroad workers and regaining traditional know-how lost with the pensioning off of experienced workers; and (6) reduce the high death toll from automobile accidents by lessening needless motor travel.

3328. Thorpe, B. E., "Northeast Track Improvement Plan May Signal New Federal Role in

Rail Operations", *National Journal*, v. 4, no. 50, 9 December 1972, pp. 1883-1888.

Describes the Transportation Department's plan for upgrading rail facilities (presently owned by Penn Central) in the Northeast Corridor (involving an expenditure of as much as $800 million), and their potential effect on rail service; presents the views of railroad industry representatives as to implications of the plan for the rest of the railroad industry (possible future action involving other companies, or rail facilities in other parts of the U.S.); describes an alternative plan proposed by Senators Hartke and Weicker, which calls for expenditure of $5.5 billion over a 13-year period (1) to improve existing track to allow faster travel by 1976, and (2) to develop a new 400-mph train that would cut travel time to 50 minutes for each leg of the Washington-New York City-Boston route.

3329. Catanese, A. J. (Ed.), *New Perspectives in Urban Transportation Research*, D. C. Heath and Company, Lexington, Mass., 1972, 272 pp. ($15.00)

Presents research findings in terms of overview, models and decision making; provides an overview in Chapter 1 in which systems analysis is evaluated as a comprehensive means for interrelating urban transportation planning and research; presents research findings related to the four most critical modelling areas for urban transportation (Chapters 2-5): (1) land use, (2) trip distribution, (3) commuting, and (4) aspects of the gravity model; discusses new work directed toward the problem of timing decisions needed for urban transportation planning (Chapter 6); includes a selected bibliography at the end of each Chapter.

3330. "Court Kills Pittsburgh Super-Tube", *New Scientist*, v. 56, no. 824, 14 December 1972, p. 640.

Announces that the innovative transit system for Pittsburgh, Pa., already under construction will not be completed -- not because of technical failings but because of political corruption, "a ham-fisted attempt to promote a locally developed technology, and illegal action by Westinghouse Electric, the firm which developed the system".

3331. Gwynne, P., "Transports of Joy", *New Scientist*, v. 56, no. 819, 9 November 1972, pp. 347-348.

Discusses the resurgence of interest in mass transit and the increasing support it is receiving from Congress; describes unsuccessful efforts of Congress during 1972 to get funds diverted from the Highway Trust Fund to support mass transit systems; describes two mass transit systems presently operating: the BART system in Oakland, California, and the "personal rapid transport system" in Morgantown, West Virginia.

3332. "Remarks by J. H. Shaffer, Administrator of FAA, before the Comstock Club", *Congressional Record*, v. 118, no. 161, 9 October 1972, pp. E8441-8443.

Reviews the history of air transportation in the U.S., and describes modern and futuristic passenger aircraft, including Boeing's 747, as well as the short- and vertical-takeoff and -landing craft (STOL and VTOL) to be used in urban areas; discusses safety, airport location, and hijacking problems which are now facing the air systems, and the efforts being made to solve them.

3333. Robinson, C. A., Jr., "U.S. Presses SST Climatic Impact Study", *Aviation Week & Space Technology*, v. 97, no. 22, 27 November 1972, pp. 50-51.

Describes the efforts of the U.S. Government's Climatic Impact Assessment Program to obtain data necessary for the Administration and Congress to reach decisions on operating regulations for SST's which must be completed by 1974; identifies the major task of the $21 million, multiyear study, viz., to probe the effects of propulsion effluents injected in the upper atmosphere by a fleet of high-altitude aircraft projected to be in service by 1990; presents a timetable for completion of the Program's activities.

3334. *Environmental Aspects of the Supersonic Transport: A Recommended Program for Research and Measurement*, Report of the Panel on Supersonic Transport Environmental Research to the Commerce Technical Advisory Board, U.S. Department of Commerce, May 1972, 40 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: 65 cents.)

Reports the findings of the Panel's study conducted because of concern as to the

environmental impact of possible large numbers of flights by Anglo-French and Russian SSTs; concludes that reliable data are lacking in certain areas, and that directed, mission-oriented research must be performed to provide a basis for decision making; recommends specific measurement programs, and points out that it is imperative that two of these programs – measurement of trace constituents in the stratosphere and of the intensity of ultraviolet light reaching the earth's surface – begin immediately.

UNITED KINGDOM

3335. Marstrand, P., "Reorganization of Government R and D in Britain: An Opportunity Missed", *Science Policy*, v. 1, no. 6, November/December, 1972, pp. 1.1-1.4.

Analyzes the various reports on the organization and activities of the research councils, and on government R&D, by Rothschild, Dainton, and the Select Committee on Science and Technology; suggests that the British Government's White Paper ("A Framework for Government Research and Development", issued 19 July 1972) will do little to improve the organization and use of science in Britain, since it (1) endorses Rothschild's customer-contractor principle without allowing adequate time for Departments to become organized as effective proxy customers, (2) failed to outline a program for the development of total government expenditure on science, and (3) ignored the evidence and recommendations provided in 4 reports by the Select Committee (on R&D, on nonreactor research, on industrial establishments in the Department of Trade and Industry, and on R&D policy).

3336. "Making Amends", *Nature*, v. 240, no. 5381, 15 December 1972, pp. 370-371.

Raises questions regarding responses by the British Government and the Department of Trade and Industry (DTI) to calls by the Select Committee on Science and Technology for the establishment of a Minister for Research and Development; discusses the implications of the DTI's explanation of how its 6 "requirements boards" will function, and its claim that the requirements boards will have responsibility for commissioning R&D at the DTI's own laboratories, nonnuclear work at the laboratories of the Atomic Energy Authority, and work of all kinds which is now assigned to industrial laboratories, universities, and the Research Councils.

3337. "DTI's 8 Per Cent Lip Service to Rothschild", *New Scientist*, v. 56, no. 816, 19 October 1972, p. 148.

Outlines the British government's plans for adopting a Rothschild-style "customer-contractor" approach to part of the civil R&D program financed by the Department of Trade and Industry (DTI); describes the organization of 5 special "requirement boards" which have recently been established, and defines their principal task: to determine the objectives and balance of the DTI's intramural and, where appropriate, extramural R&D program in the relevant technical fields and within the funds available.

3338. "Modest Shuffle", *Nature*, v. 240, no. 5376, 10 November 1972, p. 62.

Considers the possible consequences of Edward Heath's rearrangement of government posts for the new session of Britain's parliament, particularly the consequences for the administration of British science and technology; suggests that J. Davies' experience at the Department of Trade and Industry should help him considerably in his new task of coordinating British government policy toward Europe, since the most urgent tasks are grounded in industry and technology; describes the urgent issues facing P. Walker as the new Secretary of State at the Department of Trade and Industry, e.g.: (1) whether regional policy is a device for ensuring that the present distribution of industry in Britain is preserved indefinitely, or a means of helping regions dependent on declining industries over their short-term problem; and (2) how best to strike a balance between the Department's activities in R&D.

3339. "Birth of the Advisory Board for the Research Councils", *Nature*, v. 239, no. 5374, 27 October 1972, pp. 481-482.

Discusses the views of the British Council for Science Policy (CSP), which was replaced in November by the Advisory Board for Research Councils, whose

functions are to advise on civil science, on national and international science activities, on the allocation of the U.K. science budget among the research councils and other bodies, and to promote liaison between the councils and users of their research; the CSP contends that science must compete for funds with other public needs and that claims for such funds must be judged not "only on their own merit but also in relation to the needs and objectives of society"; nevertheless, it expresses concern that the planned expansion rate for science in the U.K. is inadequate to balance increased costs, resulting in a real decrease in support.

3340. "Low Opinion of High Technology", *New Scientist*, v. 56, no. 825, 21 December 1972, p. 702.

Discusses a pamphlet written by J. Jewks, published by the British Institute of Economic Affairs, in which he argues that fear is the spur for the U.K. Government's support for high technology, and that this is not only wrong in itself, but has more widespread effects on society, such as the corruption of the civil service; contends that innovation does not come mainly from large organizations, that expenditures on R&D do not correlate with economic growth, and that the "brain drain" from the U.S. is not real.

3341. "Mobility of Scientists", *Nature*, v. 240, no. 5377, 17 November 1972, p. 120.

Describes the activities of Prof. H. Bondi's task force on the interchange of scientists in Britain which is trying to emulate the system in the U.S., wherein it is quite common for scientists to move between industry, the university, and the government with immense benefit to society and employers, and without being detrimental to the career of the scientists; describes the basis for some reservations as to the success of the plan, e.g., concern as to whether a scientist leaving the university for several years could regain his place on the academic ladder, and as to the willingness of industrial employers to part with their top people.

3342. "New Concept Needed", *Nature*, v. 240, no. 5386, 10 November 1972, p. 65.

Presents highlights of a speech by Sir Brian Flowers, chairman of the Science Research Council (SRC), at the 1972 Mutland Lecture to the Institution of Structural Engineers; Flowers calls for greater cooperation between university engineering departments and industry, and for universities to run more post-experience courses in topics which the engineering industry needs; Flowers also stated that the Engineering Board of the SRC is considering supporting a Ph.D. with a new concept in engineering -- that of "Total Engineering" -- wherein the Ph.D. would study design, planning, and operational management, as well as carry out some research.

3343. *Research Associations: the Changing Pattern*, Centre for the Study of Industrial Innovation, 62 Regent St., London W1R 600, England, 1972, 94 pp. (£1.00)

Presents data on research associations in the U.K. collected through a survey, and discusses their implications for industrial and governmental policy; attempts to identify the strengths and weaknesses of the contemporary research association system, with the aim of providing a background against which the future development of research associations may be assessed.

3344. "British Industry Cuts R&D", *Industrial Research*, v. 14, no. 13, December 1972, p. 27.

Cites a report of the National Research & Development Corp., an independent public body which promotes the adoption by industry of new products and processes; the report reveals that the number of new submissions and proposals (in the year ending 31 March 1972) from Government departments and research councils dropped from 368 to 309, and those from companies decreased from 285 to 231; the report suggests that industry's R&D effort is not even keeping pace with the effects of inflation; and that a period of contraction of R&D may now have been entered; B.J.A. Bard, the managing director, acknowledged, however, that recent uncertainty over the Corporation's future could have been a factor in the decline in submissions from industry.

3345. *Scientific Research in British Universities and Colleges, 1971-72*, Her Majesty's Stationery Office, London, England, 1972, 3 vols. (Vol. I, £6.75; Vol. II, £6.25; Vol. III, £5.75.)

Provides in convenient reference form the latest information on research being

undertaken in British universities, polytechnics, and colleges in the fields of physical, biological, and social sciences; *Vol. I, Physical Sciences,* covers 36 subjects, including mathematics, computer science, physics, chemistry, and engineering disciplines, geology and the technologies of metallurgy; *Vol. II, Biological Sciences,* covers a wide field of medicine, including recent subjects such as immunology, as well as the long-established biological subjects; *Vol. III, Social Sciences,* includes research from government departments, nonacademic institutions, and the work of Ph.D. students, covering 17 topics such as economic and social history, law, industrial and social administration, psychology, human geography, and education; extensive subject indexes are included in each volume.

3346. Delin, J., "Doubling Up", *New Scientist,* v. 56, no. 814, 5 October 1972, p. 4.
Considers the problems posed by the vast increase in the number of students in higher education in the U.K., the number having more than doubled in the past 10 years; outlines actions likely to be taken by Education Minister Margaret Thatcher to improve the situation, such as trimming back expansion in the next 5 years, by channeling some of the students to polytechnics, and imposing on the universities 2-year first degree courses together with the idea of home-based study which these courses represent

3347. "NERC Reports", *Nature,* v. 239, no. 5372, 13 October 1972, p. 361.
Presents highlights of Britain's Natural Environment Research Council's annual report, which gives details of a plan for establishing a storm-surge forecasting system for the southern North Sea and the Thames estuary; reveals a continuing decrease in plankton numbers in the North Sea and North Atlantic (possibly due to pollution), outlines the Council's work in some detail, and reports on the Council's 1971 expenditures, disclosing an increase in total expenditures from £13.9 million in 1970 to £16.4 in 1971.

3348. Wade, N., "U.K. Environment Minister Deplores Rule by Decree", *Science,* v. 178, no. 4057, 13 October 1972, p. 144; also in *Environmental Science and Technology,* v. 6, no. 13, December 1972, p. 1076.
Presents views of P. Walker, British Minister for the Environment, concerning pollution control, which reveal the marked difference in the attitudes of the present British and U.S. administrations: persuasion, not law, is the approach used in the U.K., and there is "no great struggle between government and industry"; Walker is against setting arbitrary pollution standards, prefering instead to ensure that manufacturers are using the best antipollution devices available; notes that U.S. automobile emissions standards for 1975 have not been applied in the U.K. "because there is no certainty that they are feasible", and Britain's policy is to let a manufacturer and a government inspector work out a schedule of improvements.

3349. Tinker, J., "Pollution Secrecy: Nanny Takes the Lid Off", *New Scientist,* v. 56, no. 821, 23 November 1972, p. 435.
Discusses efforts by the Alkali Inspectorate to adhere to the policy of keeping secret all pollution control and emission data which has recently been abandoned by industry and government; reports that the Inspectorate still believes that the data should be restricted to those who can understand the impacts of pollution on the environment, since even the experts are liable to disagree on these impacts.

3350. "British Nuclear Research Poses Tough Question for That Nation's Government", *Inside R&D,* v. 1, no. 29, 18 October 1972, p. 4.
Reports that British companies are finding few suitors among Europe's merger-minded nuclear industries, that Europe's sole interest is in Britain's nuclear research capabilities, and that West German and Japanese nuclear industries have already tried to buy research on advanced reactors at the U.K. Atomic Energy Authority; notes that the question facing the U.K. government is whether to allow foreign research investments to enter the country, and suggests that, if the answer is yes as expected, Britain will become a nuclear R&D center for Europe and Japan — a trend that could carry over into other areas since Britain has a long-established national laboratory system to serve many industries.

3351. "U.K. Atomic Energy Authority Selling Research", *Inside R&D,* v. 1, no. 38, 20 December 1972, p. 2.
Reveals the Atomic Energy Authority's (AEA) plans to become a major supplier

of contract research to the European Community; reports that the AEA's income from sales of its services totalled nearly $6 million last fiscal year, and that a White Paper on government research (published in mid-December) not only gives the AEA freedom to go all out in its efforts to sell research, but encourages other government laboratories to do the same; this will mean stiff competition for U.S. contract research laboratories hoping to increase their business in Europe, but high-caliber help with technical problems for U.S. firms operating abroad.

3352. A. J. Surrey, *The World Market for Electrical Power Equipment: Rationalisation and Technical Change*, The Science Policy Research Unit, Box P Nuffield Building, University of Sussex, Falmer, Brighton, Sussex, BNI 9RF, England, 1972. ($28.45)

Presents a major statistical survey of the U.K. heavy electrical industry, together with an analysis of the commercial, technical, and political considerations; deals with the challenges facing the European and British industries, and examines the policy implications of changing market structures; includes detailed analyses of the U.S., Japanese, Swiss, and West German heavy electrical industries.

3353. Sir Alan Hodgkin Calls for a Biological Centre", *Nature*, v. 240, no. 5380, 8 December 1972, p. 313.

Discusses a suggestion by the President of the British Royal Society to establish a centre which would supply biological and medical research workers with animals of all kinds, special chemicals found only in certain rare plants and animals, cultures of special cells, and special research aids such as labelled antibodies; describes Sir Alan's concern that the National Environmental Research Council may suffer serious financial cuts as a result of the Government's White Paper on R&D, with resulting inability to provide equipment for marine biology, geophysics, and oceanography.

3354. "More Money for Cancer", *Nature*, v. 240, no. 5375, 3 November 1972, p. 4.

Describes recommendations made by Lord Zuckerman in a report on cancer research, which states that a sudden increase in funds for cancer research could not be used efficiently in the U.K., but "a steady and substantial increase over the years would probably yield valuable results"; Lord Zuckerman notes that the planning of new research should be governed by 3 considerations: (1) because the basic branches of biomedical research are interdependent, one branch should not be developed at the expense of the others, (2) money alone will not buy new ideas, and (3) full training programs and the provision of career prospects are needed to provide scientific talent of the quality necessary to deal with the exceptionally difficult problems associated with cancer research.

3355. "Hopes Revived", *Nature*, v. 239, no. 5374, 27 October 1972, p. 482.

Describes revitalized hopes, following a visit to Britain by a delegation from the Soviet State Committee for Science and Technology, for resuming cooperation in science and technology between the Soviet Union and Britain under the Permanent Soviet-UK Intergovernmental Commission for Cooperation in the Fields of Applied Science, Technology, Trade, and Economic Relations; points out that earlier plans for cooperation by joint working groups in specific fields and for exchange visits between British and Russian scientists and technologists have not been pursued; expresses hope for an early meeting of the Commission to resume these ventures.

U.S.S.R.

3356. Harvey, M. L., Goure, L., and Prokofieff, V., *Science and Technology as an Instrument of Soviet Policy*, Monographs in International Affairs, 1972, 219 pp. (Available from Director of Publications, Center for Advanced International Studies, Washington Research Division, Suite 811, 1225 Connecticut Ave., N.W., Washington, D.C. 20036. Price: paperback, $4.95; hardcover, $5.95.)

Provides a documentary and analytical accounting of the Soviet strategy for science and technology under contemporary conditions, and of current Soviet efforts to attain supremacy in "this main arena in the competition between socialism and capitalism", including "competition for military superiority"; examines (1) the concern of the leadership over obstacles hindering these efforts; (2) measures being taken to overcome obstacles, including measures to utilize more

effectively foreign accomplishments; (3) the mounting allocation of resources to scientific-technological progress; and (4) the special attention Moscow is giving to Western concepts regarding science and technology as a unifying force; includes extensive selections of documentary materials from Soviet sources.

3357. "More Engineers to be Trained", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.7.

Announces that engineers will account for almost half of the 9 million specialists graduating in the USSR in the period 1971 to 1975; predicts a notable increase in the enrollment of students at engineering faculties for automated control systems, applied mathematics, electronics, cybernetics, and nuclear physics; reveals that courses on the economics and management of enterprises will be introduced at engineering faculties.

3358. Pryde, P. R., "The Quest for Environmental Quality in the USSR", *American Scientist*, v. 60, no. 6, November-December, 1972, pp. 739-745.

Discusses the problems associated with natural resource utilization in the U.S.S.R. stemming from poor management practices (e.g., wastes and loss of low-grade and secondary ores during mineral extraction, soil erosion stemming from overcutting of timber and poor reforestation, and air and water pollution); notes the similarity of these problems to those experienced in the U.S., despite the fundamental economic and political differences between the two nations; describes efforts of the U.S.S.R. to protect the environment, and the overriding considerations and beliefs that hamper an all-out effort: the economics of environmental control, the emphasis placed on industrial expansion, on economic growth, and on productivity, underevaluation of natural resource worth, and faith in technology as a means of overcoming "deficiencies in nature"; suggests that without a change in priorities the U.S.S.R. will continue to play "environmental catch-up".

WASTE MANAGEMENT

3359. Dial, C. J., *New Technologies in Solid Waste Management*, U.S. Environmental Protection Agency, 1972, 18 pp. (Available from Solid Waste Management Distribution Unit, U.S. Environmental Protection Agency, Cincinnati, Ohio 45268.)

Describes the many solid waste research projects being conducted, such as those directed toward (1) finding economical means of separating the components of mixed solid waste; (2) processing mixed solid wastes and converting them into energy (for use as a supplementary fuel, for generation of electricity, and for production of steam); also describes projects on collection and transportation, incineration, and source reduction of solid waste; warns against total reliance on new technologies, and stresses that responsible officials should replace antiquated systems, improve existing collection systems, and give attention to putting their systems on a sound management basis.

3360. "Processing Urban Wastes", *Environmental News*, Environmental Protection Agency, Washington, D.C. 20460, November 1972, 2 pp.

Reports that 3 metropolitan areas — Baltimore, Maryland, San Diego County, California, and Lowell, Massachusetts — are developing new ways to extract valuable resources from urban solid wastes, using EPA grants totalling about $11,400,000; Baltimore and San Diego County will use a pyrolysis process to convert a percentage of its solid wastes into synthetic gas or fuel oil; Lowell will extract metals and glass from its own and nearby incinerators.

3361. Findley, P., "You Can Make Money by Recycling Your Paper Waste", *Congressional Record*, v. 118, no. 166, Part II, 14 October 1972, pp. E8643-8644.

Describes the activities of the Alton Box Board Co., a national leader in the collection and reuse of wastepaper and paperboard in the manufacture of paperboard; reprints a brief list of questions and answers published by Alton, which outlines the problems and opportunities in recycling paper products.

3362. Lesher, R. L., "Tackling Resource Recovery on a National Scale", *Environmental Science & Technology*, v. 6, no. 13, December 1972, pp. 1078-1081, 1083.

Describes attempts by the National Center for Resource Recovery, Inc., to hasten the applications of resources recovery from municipal waste through (1) con-

ducting thorough and systematic studies of available operating systems, (2) surveying the quality and content of municipal refuse in representative U.S. cities, (3) identifying possible markets for recovered materials, and (4) analyzing the economic suitability of resource recovery, from the standpoints of both municipalities and private operators; describes recent developments in waste collection, disposal, and treatment techniques.

3363. Kenahan, C. B., and Flint, E. P., *Bureau of Mines Research Programs on Recycling and Disposal of Mineral-, Metal-, and Energy-Based Solid Wastes*, Bureau of Mines Information Circular No. 8529, 1971, 53 pp. (Available from Bureau of Mines Publications, 4800 Forbes Ave., Pittsburgh, Pa. 15213.)

Presents a summary of Bureau of Mines in-house research on the utilization and disposal of solid wastes, accompanied by an extensive bibliography of related publications; also discusses a contract and grant program that supplements the in-house research and aids in the training of manpower in the management of mineral-, metal-, and energy-based solid wastes.

3364. *Solid Waste Management Glossary*, U.S. Environmental Protection Agency, 1972, 20 pp. (Available from U.S. Government Printing Office, Washington, D.C. 20402. Price: 30 cents.)

Provides this glossary to assist representatives of the various disciplines involved in solid waste management (e.g., engineers, planners, earth scientists, economists, as well as businessmen in a variety of services and industries), and to define terms coming into use in the literature of solid waste management that may be less well known to government officials and members of the industries involved.

3365. *The Solid Waste Fact Book*, Glass Container Manufacturers Institute, Inc., 1972, 27 pp. (Available from Public Affairs Department, Glass Container Manufacturers Institute, Inc., 330 Madison Ave., New York, N.Y. 10017.)

Provides brief answers to some questions about solid waste (primarily municipal waste): what it is, who creates it, what the dangers and solutions are, and who is doing something about it; describes the composition of municipal waste and present disposal methods.

3366. "No Such Thing as Waste", *Science Policy*, v. 1, no. 5, September/October 1972, p. 6.1 (excerpt from *Soviet News*, 13 June 1972).

Describes the new concept of waste now evolving in the U.S.S.R.; discusses the costliness of purification plants, the worldwide need for sulfur which is now being discarded as waste, and the need for developing closed-cycle production; describes, as an example, the experience of a plant, formerly discharging asbestos dust, when it reconstructed its exhaust system, purified and reheated the recirculating air, and returned it to the production premises – this relatively simple measure provided a large profit for the plant, which covered all the costs of the modification and new procedure.

3367. *Some Aspects of Plastics Waste Disposal*, Interim Report of the Working Party on Designing for Disposability, The Plastics Institute, December 1972, 12 pp. (Available from The Plastics Institute, 11 Hobart Place, London SW1W OHL, England. Price: 75 pence.)

Presents data on the current and projected future quantities of plastics in collected waste, and describes the nature of plastic materials expected to be employed in the future; discusses the problems of plastics waste disposal by current methods, the technical difficulties associated with their recovery and reuse, and the aspects of degradability; presents interim recommendations of the Working Party, chiefly concerning actions, investigations, and development work (e.g., on techniques for recovery and reuse) that should be initiated to alleviate the disposal problems associated with plastics waste.

3368. Pittman, F. K., "Management of Commercial High-Level Wastes", *AEC News Releases*, v. 3, no. 47, 22 November 1972, pp. 7-10.

Contends that the Atomic Energy Commission and the nuclear power industry "do know how to treat and manage high-level radioactive wastes safely", and "that current plans are such that all necessary actions will be taken to assure that the environment and the health and safety of the public will be protected from the

time the commercial wastes are first generated in the early months of 1973"; describes the alternative radioactive-waste-management approaches that the AEC may follow, which fall basically into 3 categories; (1) retrieval storage, (2) permanent disposal, and (3) nuclear transmutation to short-lived or nonradioactive materials.

3369. Carruthers, J., "Is Out of Sight Also Out of Mind in the Case of Nuclear Wastes", *Science Forum*, v. 5, no. 6, December 1972, pp. 20-21.

Considers the pros and cons as to the effects of "spillover" from controversies in the U.S. on Canada's nuclear power program, some claiming that it is a hindrance which is unnecessary since these controversies are inapplicable to the Canadian fuel system, while others see a direct benefit, e.g., from the issue of radioactive waste disposal; describes Canada's plan for storage — above ground in large, air-cooled, concrete mausoleums at a limited number of locations — and points out the advantages: e.g., radioactive wastes would always be readily accessible, and concentration at only a few sites would lessen the problems of safety and security; stresses the need for continuity of management of these wastes in view of the long-term storage, and suggests that the management responsibility should lie with the federal government.

WEST GERMANY

3370. "DFG Annual Report for 1971", *Science Policy*, v. 1, no. 5, September/October 1972, p. 3.2.

Presents details of Deutsche Forschungsgemeinschaft's 1971 income (DM 383.8 million) and expenditures on innovation and coordination in basic research; points out that DFG's total income was 20.9% higher in 1971 than in 1970, which indicates the importance with which the general promotion of research is regarded by the Federal and Länder Governments, and reflects the increased financial requirement for research purposes in the universities; presents a breakdown by scientific area of the research funds allocated (in DM million) and the increase over 1970 (in parentheses): humanities, 63.7 (33.8); biosciences, 110.2 (39.7); natural sciences, 89.6 (31.0); engineering sciences, 71.0 (17.9); and environmental research, 10.8 (9.1).

3371. "Research Expenditure in the German Federal Republic in 1969", *Science Policy*, v. 1, no. 6, November/December 1972, p. 3.3.

Presents major findings of a survey on 1969 research expenditures by industry, covering 850 firms: (1) these firms, excluding the chemical industry, spent ~DM 5,000m on R&D, of which DM 198m went to basic research; (2) when figures for the chemical industry were included, then total R&D spending increased to DM 7,000m, with basic research accounting for DM 368m; (3) 139 institutes spent DM 310m on joint R&D, of which DM 58m went to basic research; (4) structural steelwork, mechanical engineering, and motor vehicles and aircraft accounted for 75% of the overall basic research expenditures; (5) the major growth industries were electrical engineering, precision instruments and optics, etc., and chemicals.

3372. "DM7.6 Million for Scientific Libraries", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.4.

Announces the allocation by the German Research Association of funds for library promotion; these funds are to be spent entirely on centralized facilities for scientific libraries, joint library facilities of value to research, and model experiments for new developments, including in particular the use of data processing.

3373. "Warming Up the Rivers", *Science Policy*, v. 1, no. 5, September/October 1972, p. 2.3.

Announces the allocation of DM 200,000 by Deutsche Forschungsgemeinschaft for a priority research program into the positive and negative effects of the heating of rivers and streams by power station cooling water; the program will consist of a detailed investigation of the physical, chemical, and biological conditions within the orbit of power stations already in existence or in the course of construction, to provide information on the cooling, transport, and control of thermal effluent discharges, and on the possible biological, hygienic, and climatic consequences.

Publications Screened For This Issue

AEC News Releases (weekly) U. S. Atomic Energy Commission; Division of Public Information; Washington, D.C. 20545; No charge

American Scientist (bimonthly) 155 Whitney Ave.; New Haven, Conn. 06510; $9.00/yr in U.S.; $9.50/yr elsewhere; $1.75/single issue

Astronautics and Aeronautics (monthly) Received with membership to American Institute of Aeronautics & Astronautics; 1290 Ave. of the Americas; New York, N.Y. 10019; Dues $35.00/yr

Aviation Week & Space Technology (weekly) P.O. Box 503; Hightstown, N.J. 08520; $20/yr for qualified personnel; $30 others; $1.00/single issue

BioScience (semimonthly) American Institute of Biological Sciences; 3900 Wisconsin Ave., N.W.; Washington, D.C. 20016; $24.00/yr

Bulletin of the Atomic Scientists (monthly, except July and August) Circulation Department; 1020-24 E. 58th St.; Chicago, Ill. 60637; $8.50/yr in U.S.; $9.00/yr in Canada and Pan American Union; $9.50/yr elsewhere

The Center Magazine (bimonthly) Fund for the Republic, Inc.; 2056 Eucalyptus Hill Road; Santa Barbara, Calif. 93108; $15.00/yr Associate Membership dues include 6 issues/yr

Chemical & Engineering News (weekly) American Chemical Society; 1155 16th St., N.W.; Washington, D.C. 20036; $8.00/yr

Chemical Technology (monthly) American Chemical Society; 1155 16th St., N.W.; Washington, D.C. 20036; $18.00/yr nonmembers

Congressional Record (daily when Congress convenes) Superintendent of Documents; U.S. Government Printing Office; Washington, D.C. 20402; $45.00/yr; $3.75/mo; 25 cents/copy

Embassy of Switzerland Bulletin (triannually) Office of the Scientific Counselor to the Swiss Embassies in Washington, D.C., and Ottawa, Canada; Contact Mr. G.-A. Grin, Scientific Counselor, Embassy of Switzerland; 2900 Cathedral Ave., N.W.; Washington, D.C. 20008

Environment (monthly except Jan/Feb & Jul/Aug) Committee for Environmental Information; 438 N. Skinker Blvd.; St. Louis, Mo. 63130; $10.00/yr in U.S.; $12.00/yr elsewhere

Environmental News (irregular) Office of Public Affairs; Environmental Protection Agency; Washington, D.C. 20460; No charge

Family Planning Perspectives (quarterly) 515 Madison Ave.; New York, N.Y. 10022; Free to qualified personnel

Foreign Affairs (quarterly) 58 East 68th St.; New York, N.Y. 10021; $10.00/yr

Fortune (monthly) 541 North Fairbanks Court; Chicago, Ill. 60611; $16.00/yr U.S. possessions, and Canada; $25.00/yr elsewhere; $2.00/single issue

Futures (quarterly) Futures IPC (America) Inc.; 300 East 42 St.; New York, N.Y. 10017; $30.00/yr, $22.50 for individuals; $7.50/single issue

Futurist (bimonthly) World Future Society; P.O. Box 19285, 20th Street Station; Washington, D.C. 20036; $7.50/yr; $1.25/single issue; Institutional membership $100.00/year

Harvard Business Review (bimonthly) Subscription Service; 108 Tenth St.; Des Moines, Iowa 50305; $12.00/yr in U.S. and Canada; $15.00/yr elsewhere

The Hastings Center Report (bimonthly) Institute of Society, Ethics and the Life Sciences; 623 Warburton Ave.; Hastings-on-Hudson, N.Y. 10706; Received with Associate Membership in the Institute; Dues $15.00/yr, $7.00/yr students

Impact of Science on Society (quarterly) Unesco Publications Center; P.O. Box 433; New York, N.Y. 10016; $4.00/yr; $1.25/single issue

Industrial Research (monthly) Circulation Department; Industrial Research Building; Beverly Shores, Ind. 46301; No charge to qualified persons in the U.S.; $9.00/yr to qualified persons abroad; higher rates to nonqualified persons

Innovation (monthly except Jul and Dec) Fulfillment Manager; 265 Madison Ave.; New York, N.Y. 10016; Nonmembers: $35.00/yr in U.S. and Canada; $45.00/yr elsewhere; $5.00/single issue; single issue $7.50 to nonsubscribers or nonmembers

Inside R&D (weekly) Technical Insights, Inc.; 60 East 42nd St.; New York, N.Y. 10017; $120.00/yr

International Science Notes (intermittent) U.S. Department of State; Bureau of International Scientific and Technological Affairs; Washington, D.C. 20520; No charge

LaRecherche (11 issues/yr, in French) 4 Place de l'Odeon; 75-Paris-6^{e}; France; 75 francs/yr in France; 90 francs/yr elsewhere

Machine Design (31 issues/yr) Penton Plaza; Cleveland, Ohio 44114; $20/yr in U.S.; $35/yr elsewhere

Minerva (quarterly) 59 St. Martin's Lane; London WC2N4JS; England; $7.50/yr by air in U.S.; $8.00/yr by air in Canada; £2.50/yr in U.K. and elsewhere

Monthly Catalog of Government Publications (monthly) Superintendent of Documents; U.S. Government Printing Office; Washington, D.C. 20402; $7.00/yr in U.S.; $8.75/yr elsewhere

Mosaic (quarterly) U.S. Government Printing Office; Washington, D.C. 20402; $2.50/yr in U.S.; $3.25/yr elsewhere; 70 cents/single issue

Nature (weekly) 711 National Press Bldg.; Washington, D.C. 20004; $48.00/yr in U.S.

New Scientist (weekly) IPC Magazines; 66-69 Great Queen St.; London WC 2E 5DD, England; $20.00/yr in U.S. and Canada (by air); £6.00/yr elsewhere; 25 p/single issue

News Report (NAS, NRC, NAE) (10 issues/yr) 2101 Constitution Ave., N.W.; Washington, D.C. 20418; No charge

The OECD Observer (bimonthly) OECD Information Service; Chateau de la Muette; 2 rue Andre Pascal; F 75 Paris 16^{e}; France; $3.50/yr (£1.15, F15.00, FS13.00, DM10.50); 80 cents/issue (£0.27, F3.50, FS3.00, DM2.50)

Physics Today (monthly) American Institute of Physics; 335 East 45th St.; New York, N.Y. 10017; $7.00/yr in U.S. and possessions, Canada, and Mexico; $10.50/yr in Europe, Mid East, N. Africa (by air); $8.50/yr elsewhere

Policy Sciences (quarterly) American Elsevier Publishing Co.; 52 Vanderbilt Ave.; New York, N.Y. 10017; $17.00/yr; $5.25/single issue

The Public Interest (quarterly) P.O. Box 542; Old Chelsea Office; New York,

N.Y. 10011; $7.50/yr

PTI/NEWS (monthly) Public Technology; 1140 Connecticut Ave.; Washington, D.C. 20036

Public Policy (quarterly) Harvard University Press; 79 Garden St.; Cambridge, Mass. 02138; $9.00/yr in U.S.; $10.00/yr elsewhere; $2.75/ single issue

Research/Development (monthly) Post Office Box 2000; Greenwich, Connecticut 06830; Free to qualified requesters.

R&D Management (3 issues/yr) Basil Blackwell; 108 Cowley Road; Oxford OX41JF; England; £5.00 ($12.00)/yr; £2.00 ($4.80)/single issue

R&D Management Digest (monthly) Editorial Offices, Lomond Systems, Inc.; Mt. Airy, Md. 21771; $24.00/yr

Research Management (bimonthly) P.O. Box 51; Red Banks, N.J. 07701 $14.00/yr in U.S. and Canada; $16.00/ yr elsewhere; $3.00 single issue

Research Policy (quarterly) North Holland Publishing Company; P.O. Box 211; Amsterdam; The Netherlands; 91 Dfls/yr (about $28.50)

Saturday Review (weekly) 380 Madison Ave.; New York, N.Y. 10017; $12.00/yr

Science (weekly) American Association for the Advancement of Science; 1515 Massachusetts Ave., N.W.; Washington, D.C. 20005; $20.00/yr in U.S.; $23.00/ yr Americas; $25.00/yr overseas

Science and Government Report (24 issues/yr) P.O. Box 21123; Washington, D.C. 20009; $25.00/yr in U.S.; $35.00/yr elsewhere (by air)

Science Forum (bimonthly) University of Toronto Press; Toronto 5, Ontario; Canada; $9.00/yr; $1.75/single issue

Science News (weekly) Subscription Dept.; 231 West Center St.; Marion, Ohio 43302; $10.00/yr in U.S.; $12.00/yr in Canada and Mexico; $13.00/yr elsewhere

Science Policy (bimonthly) Science Policy Foundation; Benjamin Franklin House, 36 Craven St.; London WC2N 5NG, England; £6.40/yr in U.K.; $17.00/yr elsewhere; $22.00/yr airmail; libraries and institutions higher

Science Review (Philippine) (bimonthly) Science Planetarium; Herran-Taft Ave.; P.O. Box 3596; Manila, Philippines; No charge

Science Studies (quarterly) Macmillan Journals Ltd.; Little Essex St.; London WC 2R 3LF; England; $13.00/yr in U.S. and Canada; £5.00/yr elsewhere

The Sciences (monthly) 2 East 63rd St.; New York, N.Y. 10021; $5.00/yr; 50 cents/single issue

Scientific American (monthly) 415 Madison Ave.; New York, N.Y. 10017; $10.00/yr in U.S. and Canada; $1.00/single issue (European subscriptions from International Distributors; Vlagstraat 128, Borgerhout 2200, Belgium)

sppsg Newsletter (10 issues/yr) 7310 Broxburn Court; Bethesda, Md. 20034; $10.00/yr for individuals; $25.00/yr for institutions

Technology and Culture (quarterly) 5750 Ellis Ave.; Chicago, Ill. 60637; $12.00/yr

Technology Review (nine issues/yr) Room E19-430; Massachusetts Institute of Technology; Cambridge, Mass. 02139; $9.00/yr in U.S.; $10.00/yr elsewhere

U.S. Department of Commerce News (irregular) Public Information Office; National Oceanic and Atmospheric

Administration; Washington, D.C. 20230; No charge

Vital Speeches of the Day (semimonthly) City News Publishing Company; P.O. Box 606; Southold, N.Y. 11971; $10.00/yr; 50 cents/single issue

Washington Science Trends (weekly) Trends Publishing, Inc.; National Press Building; Washington, D.C. 20004; $50.00/yr

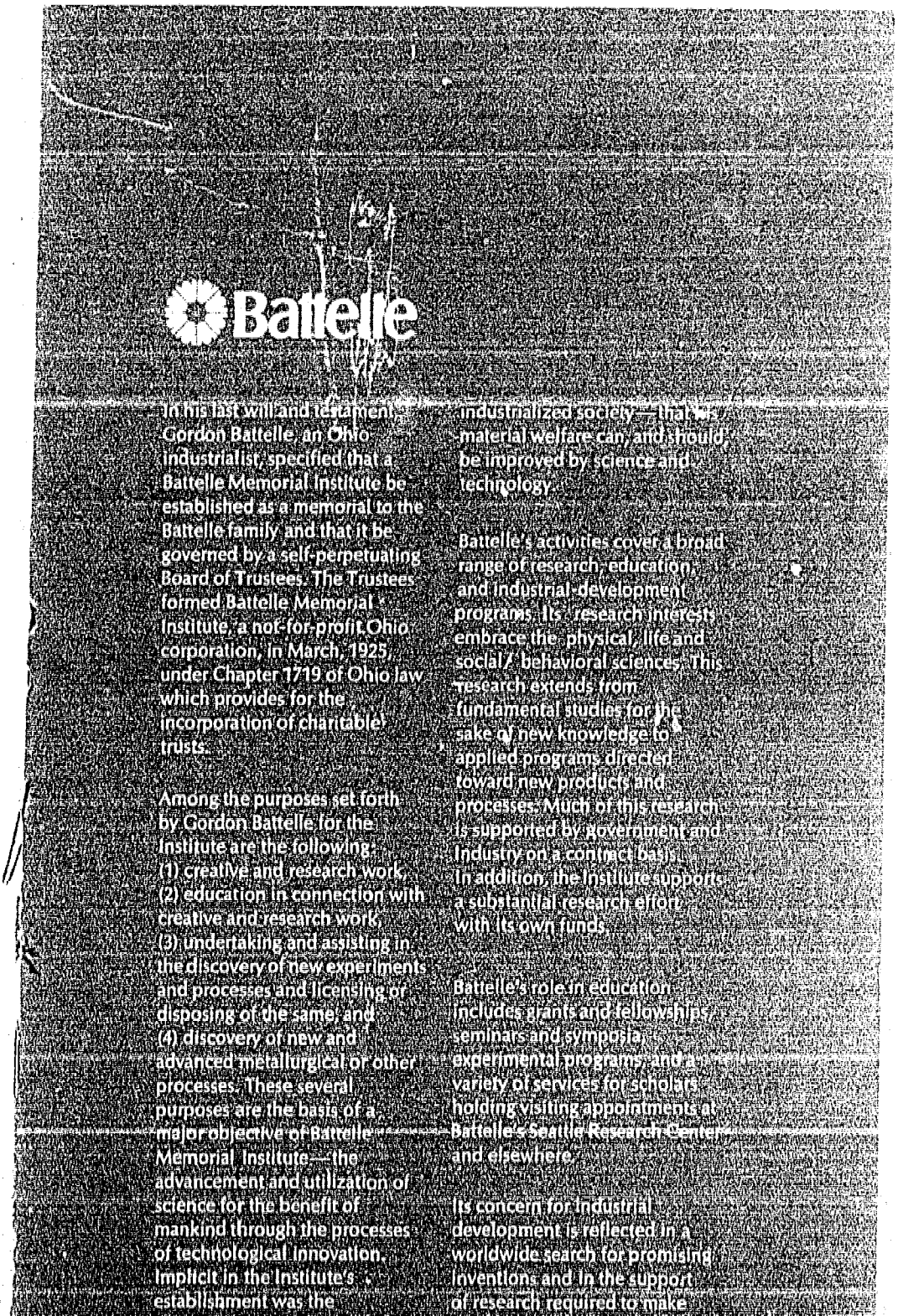
Waste Not (monthly) · National Center for Resource Recovery Inc.; 1211 Connecticut Ave., N.W.; Washington, D.C. 20036; no charge

Author Index to Volume 5

Subject Index to Volume 5

5/ONE	Abstracts 1754 through 2145
5/TWO	Abstracts 2146 through 2574
5/THREE	Abstracts 2575 through 2982
5/FOUR	Abstracts 2983 through 3371

Previous volumes of Science Policy Reviews *and its predecessor* Science Policy Bulletin *are available as microfiche from Columbus Microfilm, Inc., 3167 Cleveland Ave., Columbus, Ohio 43224, and in microfilm and enlarged reproductions from University Microfilms, Ann Arbor, Michigan 48106.*



In his last will and testament, Gordon Battelle, an Ohio industrialist, specified that a Battelle Memorial Institute be established as a memorial to the Battelle family and that it be governed by a self-perpetuating Board of Trustees. The Trustees formed Battelle Memorial Institute, a not-for-profit Ohio corporation, in March, 1925, under Chapter 1719 of Ohio law which provides for the incorporation of charitable trusts.

Among the purposes set forth by Gordon Battelle for the Institute are the following: (1) creative and research work, (2) education in connection with creative and research work, (3) undertaking and assisting in the discovery of new experiments and processes and licensing or disposing of the same, and (4) discovery of new and advanced metallurgical or other processes. These several purposes are the basis of a major objective of Battelle Memorial Institute—the advancement and utilization of science for the benefit of mankind through the processes of technological innovation. Implicit in the Institute's establishment was the

industrialized society—that material welfare can, and should, be improved by science and technology.

Battelle's activities cover a broad range of research, education, and industrial development programs. Its research interests embrace the physical, life and social/behavioral sciences. This research extends from fundamental studies for the sake of new knowledge to applied programs directed toward new products and processes. Much of this research is supported by government and industry on a contract basis. In addition, the Institute supports a substantial research effort with its own funds.

Battelle's role in education includes grants and fellowships, seminars and symposia, experimental programs, and a variety of services for scholars holding visiting appointments at Battelle's Seattle Research Center and elsewhere.

Its concern for industrial development is reflected in a worldwide search for promising inventions and in the support of research required to make